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PLANT INSPECTION WITH SPECIAL REFERENCE TO DOCK ROUTINE

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The continual growth in trade between Canada, the Orient, the various nations of the British Commonwealth, and our neighbor to the South cannot help but emphasize the increasing importance of Vancouver as a port of importation and exportation. This situation cannot but react correspondingly on the plant inspection activities at this port.

II. Origin of Incoming Vessels

The merchant marine of all nations is well represented at the port of Vancouver. Most of our nursery stock arrives on the Dutch boats (bulbs, ornamentals, and herbaceous roots), Japanese, (ornamentals and bulbs), together with a small amount of stock on the English, German, French and Australian vessels. Plant products are likely to arrive on boats of any nations.

III. Inspection Routine

A. General. The inspectors attend all incoming vessels, and special attention is paid to those carrying passengers. With an officer of the Plant Inspection Service in attendance while the passengers' baggage is being examined, the customs examiner co-operates with this officer by drawing to his notice any baggage that may contain plants or plant products, subject to examination by our Department. At the same time the inspector is on the alert to see that nothing of this nature is overlooked.

B. Specific—Oriental Vessel Inspection. On arrival of a boat of this class.

a. Inspection of white passengers' baggage is first undertaken, when all inspections made are duly recorded and data supplied to the office for further action if necessary.

b. When a lull in the above procedure allows it, a visit is paid to the lower customs office to examine the express manifest in order to discover anything thereon that might require immediate action.

c. The examination of the baggage of the overland Oriental passengers is attended to next, as these people usually entrain shortly after the boats arrive.

d. The local Oriental baggage is now surveyed and this procedure

usually takes considerable time owing to its diverse nature, and the fact that these persons straggle along in small numbers, unlike the white passengers who normally attend in a body. It is in this baggage that most of the more important interceptions are made.

e. On completion of the above, attention is now concentrated on freight shipments.

1. Shipments destined for Eastern Canadian points are checked as to permits (if nursery stock), names and addresses of consignors, consignees, marks, number of cases and route of dispatch, which information is handed on to the office for furtherance to our head office at Ottawa. From that point advices are sent out to the plant inspection office concerned.

2. Local freight shipments are examined at the dock or at the consignee's premises as the circumstances demand. If the results of the examinations are satisfactory, the appropriate certificates in the case of nursery stock are issued by the office. No documents are issued in the case of plant products. Should infection or infestation be found in these shipments, depending on the circumstances, they are ordered to be returned to the shipper, fumigated, or destroyed in the presence of a customs officer and an inspector of this department.

IV. Phases of the Work Other Than Inspection

A. Unusual Interceptions

During the years 1935 and 1936 a survey was made of various types of containers and packing materials, the results of which are quite interesting from an entomological point of view.

Host	Insect Pest
a. Willow, ash and birch crates from England	1. **Scolytus intricatus**-Ratz, which is congeneric with two European species of insects known to transmit the Dutch elm disease.
	2. **Leperisinus fraxini**-Panz.
b. Rice straw packing from Japan	1. **Pyraustids,** closely related to the corn borer.
	2. **Tribolium confusum**-Duval.
	3. **Tinea pellionella**-Linn.
	4. Species of mites, which prove very irritating to the hands of packers.

c. Rum from Jamaica	Mites on outside of leaking barrels.

B. Forwarding of Transhipments of Parasites

From time to time shipments of beneficial parasites are forwarded from the entomological departments of Japan, etc., to the Dominion Parasite Laboratory at Belleville, Ontario. A consignment of considerable interest was one of corn borer larvae parasitized with Trichogramma minutum, (Riley and Sen) from Japan to the Belleville Laboratory. These larvae had to be removed from their original containers and repacked in a special ice box before being forwarded to their eastern destination. At other times such shipments are considerably facilitated by the inspector attending to small details between boat and train.

C. Isolation and Treatment of Dock Areas on Which Either Infested or Prohibited Plant Materials are Quarantined

An interesting illustration of this type of inspection service presented itself in 1931, when a large consignment of low protein wheat from Australia (3730 sacks) was loaded on the dock at Vancouver, B.C.

As the documents covering this shipment did not contain the certificate from the proper authorities in Australia, stating it to be from an area free from flag smut of wheat (Urocystis tritici-Koernicke) it was refused entry under Dominion regulation No. 18 (Foreign) (1st Revision). Meanwhile the vessel bringing the wheat had to discharge same owing to outgoing cargo requirements. The wheat was placed on, and covered with, tarpaulins and treated with piralin. After a lapse of fourteen days it was re-shipped to Japan.

D. Inspection of Exports in Bulk at Dockside

There was a considerable amount of this work during the recent maritime workers' strike on the Pacific coast, when large consignments of onions, potatoes, and root crops were exported to the Hawaiian Islands as supplies from the United States were not available.

V. Insect Pests and Plant Diseases Intercepted

a. On passengers' baggage:-

Too much emphasis cannot be placed on this phase of our work, the truth of which is demonstrated by the list appended below of the interceptions made in passengers' baggage during the present fiscal year.

Host	Subject of Interception
Chinese mandarin oranges	Lepidosaphes gloveri Packard Parlatoria pergandii Comstock Paralatoria zizyphus Lucas Pseudomonas citri Hasse
Vaccinium ovatum sprays	An unidentified leaf miner, not recorded, to the best of my knowledge, on the Pacific coast.
Japanese Cherry trees	Aspidiotus forbesi Johnson Aspidiotus ostreaeformis Curtis
Malus	Aspidiotus perniciosus Comstock
Juniper	Eriophyes ramosus Hodgkins
Sand pears	Laspyresia molesta Busck
Gladioli	Taeniothrips gladioli (M. & S.)
Apples	Carpocapsa pomonella Linn
Corn	Heliothis obsoleta Fabr
Sweet Potatoes	Cylas formicarius Fabr
Pineapples	Pseudococcus longispinosus Targioni
Camellia	Diaspis camelliae

b. Freight Interceptions.

Host	Insect Pest or Disease
1. Stored grain	Sititroga cerealella Olivier Ephestia kuehniella Zeller Tribolium confusum Duval Tenebroides mauritanicus Linn Necrobia rufipes De Geer Mylabris obtectus Say
2. Nuts	Balaninus rectus Say Plodia interpunctella Say
3. Vegetables—Spinach & Celery	Heterodera Marioni Goodey
Corn	Heliothis obsoleta Fabr
Tomato	Gnorishema lycopersicella Busck

4.	Fruit—Apples	Carpocapsa pomonella -Linn
	Pears	Chrysomphalus aurantii -Maskell
	Citrus Fruits	Coccus pseudomagnoliarum-Kuwana
5.	Bulbs	Anguillulina dipsaci -Kuhn
		Pseudomonas hyacinthi -Wakker
		Merodon equestris -Fabr
		Eumerus strigatus -Fallen
		Rhizoglyphus hyacinthi -Boisd
		Rhizopus necans -Massee
		Septoria gladioli- Passer
		Pseudomonas marginata McCulloch

c. Nursery Stock and Plant Products Refused Entry Under Departmental Regulations

Several ornamental dish plantings containing Japanese soil.	
Five leaved pinus	Japan
Wheat	Australia
Mango fruits	Hawaii
Papaya	"
Anthurium flowers	
Mauna Loa blossoms	"
Frangipani blossoms	"
Gardenia	"
Ti tree logs and leaves	"
Strelitzia reginae plants	"
"Wood rose" flowers (dried)	"

Bibliography

1. Manual of Plant Diseases—F. D. Heald, McGraw-Hill Book Co., New York

2. Insects of Western North America—E. O. Essig, The MacMillan Co. New York

3. Destructive and Useful Insects—C. C. Metcalf and W. P. Flint, McGraw-Hill Book Co., New York

4. An Introduction to Entomology—J. H. Comstock, Comstock Publishing Co., Ithaca, N.Y.

5. Department Records, Plant Inspection Office, Vancouver.

NOTES ON SOME PHENOMENAL FEEDING OF TICKS

by J. D. Gregson
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The following are notes on a series of experiments that have been conducted along such lines tending to contribute towards a better knowledge of tick feeding, its varying rates and its relation to disease. They are mentioned at this date as subjects of general interest, and to save confusion have been grouped according to the various procedures that have been followed. Their relationship and bearing to each other is withheld until such time as conclusions may be drawn from the combined results of these and other observations.

Infesting Experiments

1) The relation of the rate of tick feeding to tick paralysis was mentioned in the writer's last report to this society (1). To the instances of varying rates of engorgement then given, may be added another striking example.

A series of ticks **(Dermacentor andersoni)** obtained from Rayleigh, B. C. on April 30, 1936 were placed on a sheep on August 9. At the end of 9 days, 18 live female ticks were recovered. Of these, 3 had engorged and dropped, I was three-quarters engorged, the remaining 14 were still flat, even though they had been attached throughout the entire period. It is assumed that in spring, all would have engorged under a maximum of 7 or 8 days. Last year's studies (1) suggested that the cause of this abnormal feeding lay primarily in the ticks. Histological studies of such ticks, after feeding tests, have as yet revealed no unusual structural differences, beyond advanced and retarded assimilative processes. Comparisons of the flat, slow- and fast-engorging ticks, is unfortunately impossible, since at that stage their feeding potentialities are not known.

2) On January 18, 1937, a series of **D. andersoni** female ticks that had been collected during the previous spring and had since been kept under a natural climate were subjected to the following conditions for a week:

(a) Kept at 70° F., humidity 100%, and irradiated with a mercury arc lamp for 10 minutes each day, (distance from lamp: 12 inches).

(b) Kept at 70° F., humidity 100%.

(c) Fluctuated at 12-hour intervals from 0° F. to 70° F., saturated humidity.

(d) Kept at 0° F., humidity 100%.

These ticks were then infested in four groups on a sheep kept at room temperature. At the end of 5 days the groups were removed and the excreta of each set collected from each cage.

The effect of the various treatments was illustrated exceptionally well by the clearly-defined differences of size and colour shades of the ticks of each group (see accompanying photograph), and by the graph of weights of ticks and excreta representing the proportions of blood extracted by each of the four groups of ticks. The corresponding average length of the ticks and the average weight of ticks and excreta of each of the above mentioned groups were 9.5, 8.5, 8.0 and 6.5 mm., and .14, .11, .10 and .04 grams. The irradiated ticks fed nearly twice as fast as those that had been kept at zero temperature.

Artificial Feeding Experiments

Owing to the impracticability of keeping a nutrient medium sterile, all experiments involving the artificial feeding of ticks are necessarily limited to a maximum of 30 hours duration at room temperature.

Since signs of engorgement do not become apparent, externally, until some 20 hours after attachment, internal changes are observed to determine whether assimilation of blood has commenced. A slight engorgement of less than 6 hours is accompanied by the diminishing of certain intracellular purple particles within the gut, together with the appearance of numerous fuchsin-staining cytoplasmic globules.

3) Five ticks were individually invited to feed by a process described by Vainshtein for forced feeding of mosquitoes (2). The tick was placed in a glass tube, tapered at the head end and plugged with cotton wool to prevent the animal from backing out. The capillary stem of a small funnel was inserted through the tapered end and placed over the hypostome of the tick, the palps being pushed back as during normal feeding. Haemolysed defibrinated sheep's blood was placed in the capillary funnel and the tick kept at room temperature for 30 hours.

Of the 5 ticks so treated, 1 was found, by sectioning, to have taken in blood and had commenced to engorge.

4) Four pairs of female **D. andersoni** ticks were taken from laboratory stock on January 17, 1937 and placed on mouse skins stretched over the ends of vials containing defibrinated haemolysed sheep's blood. After 30 hours, half of these ticks had attached. Microscopic examination showed that only one had commenced to engorge.

Totze (3), in his account on the artificial feeding of ticks **(Ixodes ricinus)**, states that he could induce the nymphs and adults to feed by such means only after removal of the tips of the first pair of legs, in which the olfactory organ is situated.

In Vivo Experiments

5) A dozen female **D. andersoni** ticks were encised around the posterior margin of the integument and placed in mediums of de-

fibrinated haemolysed sheep or guinea pig blood. Examined after intervals of 6 to 18 hours, several of these ticks showed indications of engorgement. Assimilation was, however, noted only in instances where the gut had been ruptured, permitting the access of blood. In instances where the gut had not been cut, or in other experiments where attempts to inject blood into the gut proved unsuccessful, it was found that the surrounding fluid had failed to bring about assimilative changes.

In Vitro Experiments

6) Several attempts have been made to culture fragments of living tick gut in a medium of sterile defibrinated haemolysed blood. In no cases, where the gut has been removed from the tick, has the writer been able to obtain the characteristic assimilative changes.

Acknowledgement

The writer is indebted to Dr. A. G. Naismith of the Royal Inland Hospital at Kamloops for advice and for the privilege of using certain apparatus not available at this laboratory.

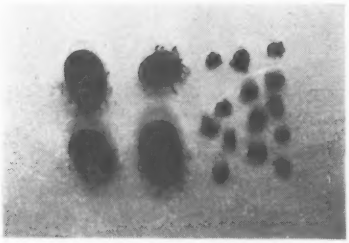
References

(1). Gregson, J. D.; Studies on the Rate of Tick Feeding in Relation to Disease; Proc. B. C. Ent. Soc., 1936.

(2). Vainshtein, N. B.; On the Technique of Forced Feeding of Mosquitoes; Rev. Applied Ent., Series B, Vol. 24, Part 11, November 1936.

(3). Totze, R:; Contribution to the Physiology of the Senses of Ticks; Rev. Applied Ent., Series B, Vol. 21, Part 8, August 1933.

(February 5th, 1937)



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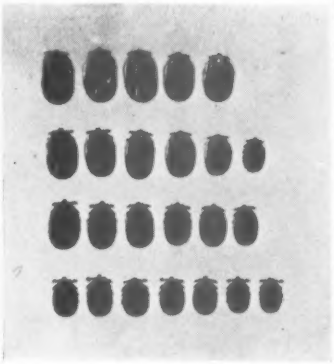

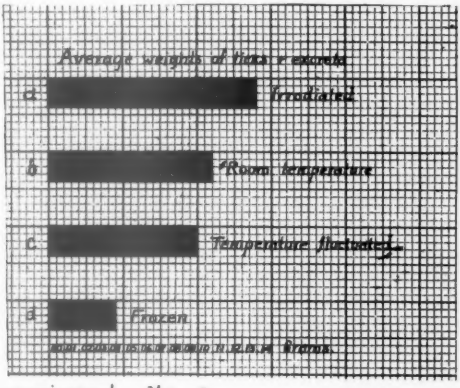

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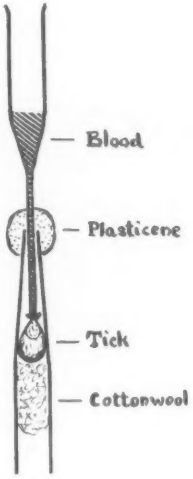

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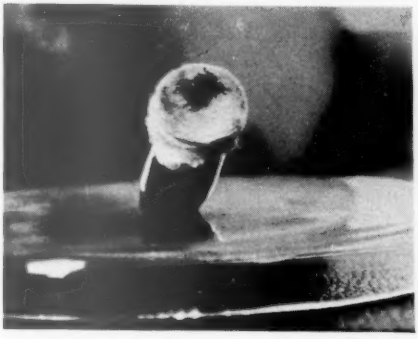
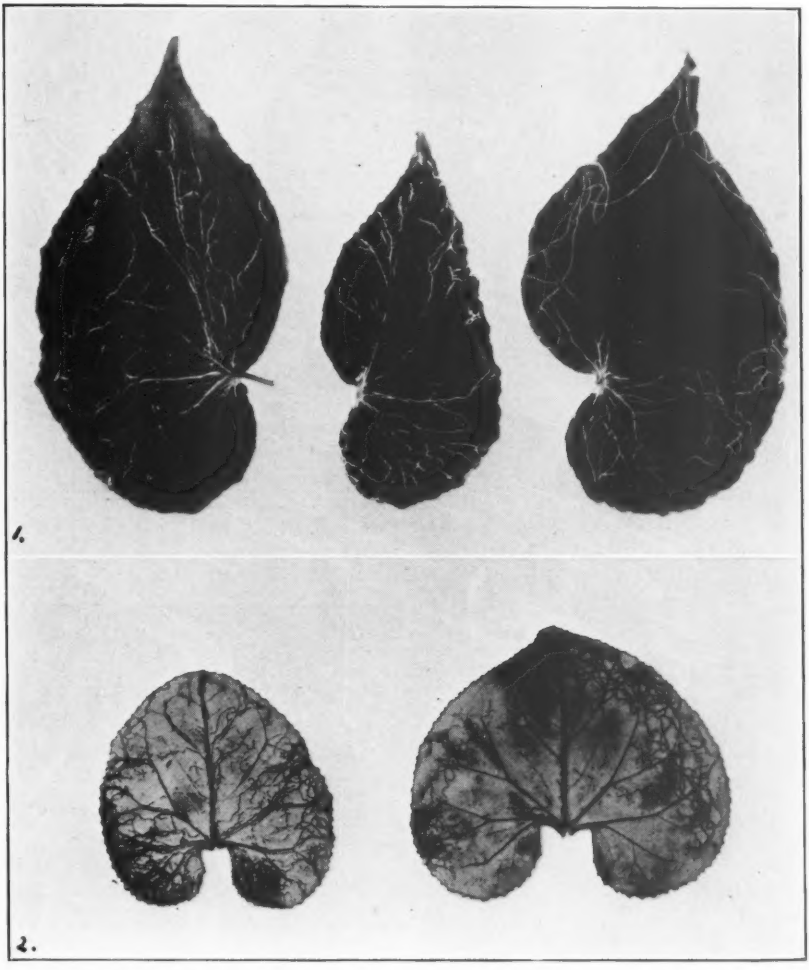


Artificial feeding experiment No. 4.



Damage to the Foliage of Greenhouse Plants caused by the Long Winged Thrips *(Scirtothrips longipennis* Bagn.*)* (Fig. 1) on the upper surface of begonia leaves and (Fig. 2) on the lower surface of cyclamen leaves, showing the characteristic dark, rust-brown, irregular, serpentine lines.

THE LONG WINGED THRIPS (**Scirtothrips longipennis** Bagn.) AND ITS CONTROL IN GREENHOUSES

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Introduction

In recent years, greenhouse operators of Vancouver Island have suffered heavy losses caused by the feeding of the adults and larvae of the Long Winged Thrips (**Scirtothrips longipennis** Bagn.) on greenhouse crops. Eight different species of plants were found to be attacked and of these, begonia and cyclamen were the most severely damaged. Owing to its minute size, this thrips remained unnoticed at first and the injury, which consisted of peculiar, rusty-brown, corky serpentine lines, had been attributed to other causes such as nematodes, fungi, etc. It appeared that the injury was not being controlled by the use of nicotine-soap and other spraying measures and the damage continued to increase. During the winter months of 1935, the losses became so extensive that the need of a thorough investigation was realized and studies were commenced in order to determine the nature and extent of the injury and its control.

Nature and Extent of Injury

The Long Winged Thrips obtains its food by puncturing the tissues of the leaves, stems, and flowers and draining the contents of the cells, causing the cell walls to collapse. Growth expansion of the surrounding living cells leaves the punctured and dried areas sunken and distorted. Finally, the characteristic dark, rusty-brown, irregular serpentine corky lines appear, the pattern of which is not unlike that of a topographic map. It is due to this rusty brown color of the affected parts that the injury has received such names as "rust", or "cork rust", in spite of the fact that it has nothing to do with the fungus rusts (**Basidiomycetes**).

On begonias, the injury appears mainly on the upper side, while on cyclamen, it is chiefly the under side of the leaves that are attacked. The damage to cyclamen flowers is much more severe, resembling closely the injury caused by the cyclamen mite. In some cases, the thrips feed beneath the bud scales of the cyclamen bloom and so stunt and distort the bloom that it never fully opens. In begonias, the blossoms are rarely affected, except in severe attacks, in which case they drop before they open out.

It is mainly the newly unfolding and tender leaves and buds that are atacked and, as the feeding is mostly confined to the surface, no

part of the leaf is killed outright. However, in cases where the foliage is subjected to prolonged attack, the function of all the leaves is so disturbed that the plants become stunted and never reach their normal size. As the attack continues, successive leaves are badly injured until, in extreme cases, the entire plant is killed.

Host Plants and Distribution

Begonia and cyclamen appear to be the favorite host plants of the Long Winged Thrips under glass and the tender and thin-leaved varieties are preferred. The following varieties of begonias are attacked:- Gloire de Lorraine, Lady Peterson, Metallica, Eclipse and the tuberous begonias. We have also found it on gloxinia, azalea, anthurium, orchids, gardenia and tradescantia.

Although this species of thrips is very minute and has been little studied, at the present time it has rather a wide range of distribution. Pape (7) during 1933, found the species on Gloire de Lorraine, Ensign and Eclipse varieties of Begonia hybrids and also on anthurium, caladium and philidendron in greenhouses in Germany and Denmark. Speyer (6) also adds a recent (1935) record of an infestation on cyclamen in greenhouses in Cheshunt, Herts., England. Other workers are reported by Essig (2) as finding it on olive and pine in Southern California. Bailey (1) also lists it from California, but does not consider it of economic importance. As it becomes better known it will probably be found to occur in a great many other areas as well.

Description and Habits

Adult: The Long Winged Thrips is a member of the Family **Thripidae** or narrow-winged thrips and is among the smallest of the related injurious **Thysanoptera.** To the unaided eye it resembles a tiny dust particle. The total length of the female, which is noticeably larger than the male, measures 0.75 to 0.96 mm. The color of the adult is translucent orange-yellow with dusky colored wings extending beyond the abdomen by one-fourth its length. The wings are pointed at the tip, with the forewings having two longitudinal veins. The fore vein has usually 8 spines, arranged in two groups of 3 and 2 respectively, and 3 spaced evenly on the distal part. The first and last group of 3 appears to be constant but the second group varies from 2 to 3 spines. The costa of the fore wings is thickly set with from 18 to 22 rather long spines. The costal fringe on the fore wing is about three times as long as the costal spines. The 3 evenly spaced spines on the hind vein are constant and are situated directly below the spaces between the 3 evenly spaced spines on the distal part of the fore vein. The head is small, about one-half as long as wide, and a considerable proportion of it is occupied by the large, dark purple or black compound eyes. Three red ocelli occupy the space between the compound

eyes on the upper surface of the head. The rostrum or mouth cone is short and blunt, not quite reaching across the prothorax, and is tipped with black. The antennae are about twice as long as the head, uniform yellow, having 8 segments, each bearing one or more setae.

Like other thrips in greenhouses, the life cycle of this species is short and breeding is continuous when the temperature is constantly high. Being a relatively new pest in greenhouses, the information on its development under glass is lacking. Studies are being conducted at the present time in Victoria to secure this data.

The adults and larvae are generally found feeding in colonies. They are active feeders, especially on bright warm days at a temperature of over 75° F., when they exhibit increased activity and cause a considerable amount of injury in a short time. The nature of the injury, which subsequently appears as serpentine corky lines, is related to the feeding habits of the thrips. When feeding, they rasp the surface of the plant tissue and move slowly forward at the same time, leaving a characteristic, irregular, colorless, linear excoriation. It is generally 9 to 16 days after the tissue has been lacerated that the brown, corky effect appears. This explains why the thrips are not always found where the corky lines are evident. Thus, while the cork building reaction of the plant is in process, the insects usually move from the more or less dried and lifeless earlier leaves that were first attacked, to the neighboring young tender foliage.

Control

Very little work has been conducted on the control of the Long Winged Thrips. Pape (7) found that cyanogas at the rate of 30 to 40 grams per 100 cubic metres and refumigation for one hour with a proprietary insecticide was 100 per cent effective, but he does not recommend its use when Lorraine begonias are to be treated. Speyer (6), during 1935, successfully controlled an infestation of this thrips on cyclamen, using a dust containing 4 per cent nicotine and equal parts of naphthalene and magnesium hydrate.

Experimental Control Measures

Tests with various dusts and sprays were conducted under greenhouse and laboratory conditions, using the Lorraine variety of begonia, because it was the most heavily infested of the major greenhouse crops and because of its extreme sensitiveness to chemical spray injury. Briefly stated, the following are the dusts and sprays applied at intervals of seven days during a period of five weeks, using 20 plants in each experiment;-

Dusts 1. Naphthalene and ashes dust, 30% naphthalene to 70% fine coal ashes.

2. 2% nicotine and lime dust.
3. 2% nicotine and coal ashes dust.

The 2% nicotine-ashes dust was superior, in that it was more toxic than the naphthalene-ashes dust and it did not leave a white chalk-like residue adhering to the foliage. All the dusts tested, however, had this disadvantage, that owing to the curled or distorted leaves they did not penetrate to all protected areas in which the thrips feed.

Sprays 1. Coal oil emulsion:- coil oil 2 oz.; whale oil soap 1 oz.; water 1 gal.; nicotine sulphate 1 teaspoon.

2. Paris green 1 teaspoon; hydrated lime 2 oz.; water 3 gals.
3. **Volck 1% with 1 teaspoon of nicotine sulphate per gallon of spray solution added.**
4. Derris (4% rotenone) 1 oz.; whale oil soap 1 oz.; water 1 gal.
5. Molasses 4 teaspoons; nicotine sulphate 2 teaspoons; water 1 gal.

The results from the spray tests showed that the coal oil emulsion with nicotine, and the derris soap solution, were superior to the other formulae tested. The Volck, Paris green, and molasses-nicotine sprays caused slight to severe burning which increased as the successive applications were made. The coal oil emulsion was considered more valuable from a practical standpoint, in view of the fact that it was also effective against mealybugs.

Following these tests, the growers who experienced losses from thrips injury were advised to use the coal oil emulsion formula. During the period from May 15 to Dec. 10th, 1936, the operators of the two greenhouses in which the experiments were conducted continued to spray more than 2,400 begonia plants at 10 day intervals and succeeded in growing their entire stock, free from insect damage of any kind. The only objection to using this emulsion is that it contains whale oil soap having an unpleasant odor which is objectionable to many purchasers of ornamental plants.

Studies were continued during the winter months of 1936-37 and an improved coal oil emulsion was developed, using a linseed oil soap, in place of the whale oil soap. The stock emulsion contains:- coal oil 10 oz.; water 5 oz.; linseed oil soap 1 oz. To prepare, heat the water and add the soap, stirring till all the soap is dissolved. Then pour the coal oil slowly into the warm soap solution as it is being stirred. This mixture is then thoroughly churned or emulsified by using a bucket pump, egg beater or "Daisy" homogenizer. The resulting thick creamy emulsion is a very stable stock solution and should be used at the rate of 3 oz. (6 tablespoons) to 1 gallon of water with 1 to 2 teaspoons of nicotine sulphate added, per gallon of spray solution. This improved

formula is just as effective as the whale oil soap formula and has given much satisfaction to the greenhouse men, their begonia and cyclamen crops being the best they have had for some years.

Summary

The Long Winged Thrips is a serious pest in greenhouses. The presence of the thrips is manifested by the appearance of characteristic rusty-brown, corky, serpentine lines on the leaves, stems and flowers of infested plants. Although begonias and cyclamen are preferred hosts, it is also destructive on gardenia, gloxinia, azalea, orchid, anthurium and tradescantia. Since the youngest leaves and buds are attacked first, and the corky tissue is not evident until 9 to 16 days after the plant tissue is lacerated by the thrips, it is difficult to detect the early stages of infestation. The life cycle of this species in greenhouses is short and development is greatly accelerated on bright warm days when the temperature is above 75° F. Spraying every 7 to 10 days with a coal oil emulsion with nicotine added, proved to be the best method of eradicating the thrips from begonia plants.

Acknowledgments

I wish to acknowledge the assistance of Mr. W. Downes, Officer in Charge of the Victoria Entomological Laboratory, in his supervision of the work and helpful suggestions. My thanks are also due to Mr. Steinweden, California, for determining the thrips species, and to Mr. H. Edwards, Graduate Assistant at the Laboratory of Plant Pathology, Saanichton, B. C., who willingly co-operated by supplying some of the photographs illustrating the nature of the thrips injury.

References

(1). Bailey, S. F. 1935. A list of the Thysanoptera of California, Pan. Pacific Entomologist, Vol. 11, No. 4, p. 163.

(2). Essig, E. O. 1926. Insect of Western North America, Macmillan and Co., N.Y., p. 188.

(3). Moulton, D. 1931. Western Thysanoptera of Economic Importance. Jour. Ec. Ent., Vol. 24, p. 1033.

(4). 1909. The Orange Thrips, U.S.D.A., Bur. Ent., Tech. Ser. 12, pt. 7, p. 119-122.

(5). Speyer, E. R. 1934. Entomological Investigations, Rep. Exp. Res. Sta., Cheshunt, Herts., England, Sept. 1934.

(6). 1935. Entomological Investigations, Rep. Exp. Res. Sta., Cheshunt, Herts., England, Aug. 1935.

(7). Pape, H., Lange, A., and Meithe, E. 1933. Die Begonien, description, culture and history. Institute of Horticulture in Brienz, published by Eugen Ulmer, Stuttgart, Olgastrabe 83, Germany.

MASS COLLECTING OF LABIA MINOR L., THE SMALL EARWIG

by J. K. Jacob

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Besides other orders, British Columbia is particularly blessed with representatives of Dermaptera. The following species are found here:-

Forficula auricularia L., the common earwig.

Anisolabis maritima Géné, the seaside earwig.

Anisolabis annulipes Lucas, the ring-legged earwig, also known as **Euboriella annulipes** Lucas. and

Labia minor Linn., the small earwig.

Of these species, **Labia minor** is Palaearctic, but whether it entered America in historic or geologic times is not definitely known, although it is generally supposed that it was introduced accidentally by man. The other three species are cosmopolitan, which have been introduced into Canada by commerce and which have become established on the British Columbia coast.

In numbers, **Forficula auricularia** far surpasses all the others and is probably present in all of the southern coastal areas of British Columbia. **Anisolabis maritima** is present in large numbers on an island three miles out of Departure Bay, Nanaimo, and on the mainland of Vancouver Island, near the Biological Station. It is found in coarse gravel at high tide mark, living in a narrow belt some two feet wide where the water generally deposits a strip of seaweed and flotsam. **Anisolabis annulipes, so far,** is present only at Victoria, in the gardens of the Empress Hotel.

Labia minor has been collected singly or in small numbers at Salmon Arm, Vernon, Chilliwack, Agassiz, Courtenay and Vancouver. This is a small species and has the following measurements: body 4-5 mm., tegmina 1.5 mm., forceps of male 2 mm., and female 1.2 mm.

In looking up the available records for North America, I find very few and only one or two specimens in each case. This may be explained by their nocturnal habits and rapid flight which is like that of rove beetles. In the United States the majority have been caught in flight, some have been found under bark, and others have been caught around lights to which they were attracted. The species has been taken in the New England states every month from May to November, from stables, manure heaps and fungi. In distribution, it occurs westward from the New England states to the prairie states including Virginia, North Carolina, Ohio, Indiana, Minnesota, South Dakota and Florida. In eastern Canada, it occurs in Nova Scotia, New Bruns-

wick, Quebec, Ontario and Manitoba. In the west, it is found in California, Oregon and British Columbia.

It is of interest, therefore, to record mass collecting of this species.

One evening in the month of June, I was looking for worms suitable for sectioning and, as those feeding in dung hills would have no sand within them, I went to the nearest farm, located just south of Kerrisdale and west of Marine Drive Golf Course. The dung hill consisted of cow manure and straw and was about 10 feet by 10 feet and about 50 feet long. On the end exposed to the sun and hidden just under the surface of the heap and in manure, partly dried and quite warm from the heat of the sun and natural decomposition, I found a few of the small earwigs. As their movements were very rapid, they were rather difficult to catch with forceps. By removing a part of this layer and placing it in a bag, I thought probably there would be some within the material, and by examining each small piece carefully on a sheet of white paper, I would be able to get them more easily. Such proved to be the case, but they were in far greater numbers than I had at first anticipated. Each small piece was broken up completely and as the earwigs came to view they were picked up with forceps and placed in alcohol. In a cubic foot of material I obtained between two and three hundred specimens, most of them adults but also a few of the immature stages.

Although **Forficula auricularia** has appeared along the northern portion of the Pacific coast in far greater numbers than probably anywhere else in any of the regions into which it has become introduced, greatly surpassing in numbers any infestations that have ever been reported from its native land, this is due to a very favorable gross climate. Therefore, these large numbers cannot be correlated with those of **Labia minor**, which is governed by micro-climate.

SOME FOOD PLANTS OF LEPIDOPTEROUS LARVAE

List No. 5

by J. R. J. Llewellyn-Jones
Cobble Hill, Vancouver Island, B.C.

RHOPALOCERA

***Cynthia cardui** L. Species of Burdock. (**Arctium lappa** L. & **A. minus** Bernh.)

Incisalia iroides Bdv. Ocean Spray (**Spirea discolor** Pursh.)

***Polygonia oreas silenus** Edw. Wild Gooseberry (**Ribes divaricatum** Dougl.)

HETEROCERA

Eriopyga irrorata Sm. Maple (**Acer macrophyllum** Pursh.), Willows (**Salix scouleriana** (Hook.) Barr. & **S. hookeriana** Barr.), Wild Cherry (**Prunus emarginata** Dougl.), June-berry (**Amelanchier florida** Lindl.), Alder (**Alnus rubra** Bong.), Red Flowered Currant (**Ribes sanguineum** Pursh.), Plantains (**Plantago major** L., & **P. lanceolata** L.).

***Halisidota maculata angulifera** Wlk. Ocean Spray (**Spirea discolor** Pursh.)

***Lycophotia margaritosa** Haw. Wild Cherry (**Prunus emarginata** Dougl., Alder (**Alnus rubra** Bong.), June-berry (**Amelanchier florida** Lindl.), Willows (**Salix hookeriana** Barr. & **S. scouleriana** Hook.) (Barr.).

Malacosoma pluvialis Dyar. Species of Apple, Crab Apple, (**Pyrus diversifolia** Bong.), Aspen (**Populus tremuloides** Michx.), Lombardy Poplar (W. D.) Alder (**Alnus rubra** Bong.), Garry Oak (**Quercus garryana** Dougl.), Rose (**Rosa gymnocarpa** Nutt. & **R. nutkana** Presl.), Species of Willows, Mountain Ash (**Sorbus aucuparia.**).

Malacosoma disstria erosa Stretch. Aspen (**Populus tremuloides** Michx.) (G. J. S.)

***Notolophus antiqua badia** Hy Edw. Species of Blackberry, Loganberry, Red Flowered Currant (**Ribes sanguineum** Pursh.), Black Hawthorn (**Crataegus brevispina** Dougl.), June-berry (**Amelanchier florida** Lindl.).

Perigrapha normalis Grt. Alder (**Alnus rubra** Bong.), Maple (**Acer macrophyllum** Pursh.), Ocean Spray (**Spirea discolor** Pursh.), June-berry (**Amelanchier florida** Lindl.), Wild Cherry (**Prunus emarginata** Dougl.), Red Flowered Currant (**Ribes sanguineum**

Pursh.), Species of Willows (**Salix hookeriana** Barr. & **S. scouleriana** (Hook) Barr.)

Pero giganteus Grossb. Red Flowered Currant (**Ribes sanguineum** Pursh.), Alder (**Alnus rubra** Bong.), Ocean Spray (**Spirea** discolor Pursh.).

Following are abbreviations, marks, etc., used in the above list:-

W.D.—W. Downes, Dominion Entomological Laboratory, Victoria, B. C.

G.J.S.—Professor G. J. Spencer, Department of Zoology, University of British Columbia, Vancouver, B. C.

An asterisk (*) denotes that the species has been mentioned before in the lists and that the information here offered is either additional, or an amplification of what has been previously reported.

BIOLOGICAL AND MORPHOLOGICAL DIFFERENCES BETWEEN **Eriosoma Crataegi** (Oestlund) **and Eriosoma Lanigera** (Haus.)

By A. D. Heriot
Dominion Entomological Laboratory, Vernon, B. C.

Few incidents in the biology of aphides have aroused so great an interest, or have been the subject of so much discussion, as the migration to elm of the woolly aphis of apple in Eastern North America. In every other region of the world, where apples are grown, **Eriosoma lanigera** (Haus.) confines its attention almost exclusively to **Pyrus malus** throughout the year. Alate sexuparae appear among the colonies of apterae in varying degrees of abundance, but it is only in North America, east of the Rockies, that these winged forms are recorded to migrate in the fall to **Ulmus americana,** and there to give rise to several generations. In June of the following year, the wild thorns and mountain ash, share with the apple the attention of the spring migrants, which forsake the elm for these summer host plants.

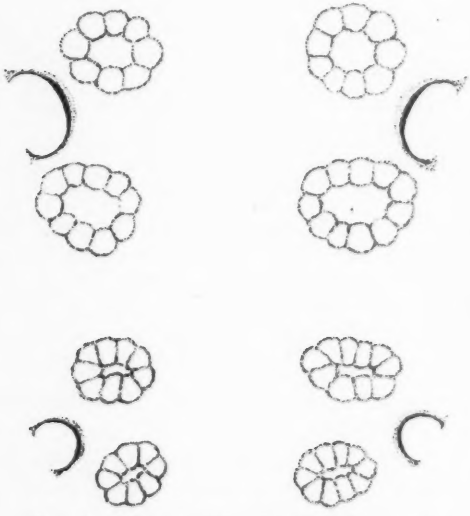

Fig. I.—Above: Waxglands and cornicles of *E. crataegi*
Below: Waxglands and cornicles of *E. lanigera*

Fig. II.—Waxplate of adult female of *E. crataegi*

In view of this connection with **Ulmus americana,** the woolly aphis of apple has generally been conceded to be of American origin, although

it derives both its generic and specific names from Europe. A serious outbreak of this orchard pest occurred in England as long ago as the close of the eighteenth century and the commonly called "American blight" was first described and named in 1802, in Germany.

E. lanigera appears to have spread through Europe and Asia far more rapidly than in its alleged country of origin. For example, it was well established in India, in 1888, at a time when it was acknowledged to be prevalent in the south of the U. S. A., but was unknown as a pest of apple in the Northern States of the Union. Another woolly aphis was recorded on **Crataegus** in Minnesota in 1887, and this, ten years previously, had been noted on the wild thorns in Ontario under the name of **lanigera**, which it closely resembles.

Oestlund gave specific standing to the woolly aphis of thorn, and despite statements to the contrary, appearing in recent literature, a reference to this original brief description clearly shows that Oestlund considered, in 1887, that his **crataegi** was "evidently not **lanigera.**" His reasons will be discussed later.

While the prevalence and distribution of **lanigera** in North America does not appear to have been general fifty years ago, everything points to the widespread and common occurrence of the thorn aphis. Baker says "that in the north he had seen the insect far removed from orchard trees" while Becker, in the southern State of Arkansas, claims "that by being constantly subjected to attack by woolly aphis, **Crataegus** has acquired a strong immunity to this pest." Likewise in the west, Gillette was sufficiently well acquainted with the thorn aphis in Colorado to remark on its close resemblance to another native species, **Eriosoma americana** Riley, on the native elms.

There is thus ample evidence for concluding that the native thorns and elms of North America east of the Rockies have been infested by woolly aphis from remote times. Up to the eventful years 1912-15, when **lanigera's** elm connection was recorded in Maine and Virginia, nothing whatever was known of the biology of the woolly aphis of thorn or of the native **Eriosomae** on **Ulmus americana.** What is known today concerning their migratory habits and host plants is largely due to the discoveries of Dr. Patch in Maine.

Concerning these, the migration of **Eriosoma ulmi** L. between **Ulmus campestris** and **Ribes** was already well known in Europe, when, in 1912, the aphis responsible for the rosette leaf curl of **Ulmus americana** was proved to migrate to both thorn and mountain ash in Maine. In addition to these native summer host plants, the spring migrant from elm rosette readily accepted the cultivated apple.

The rosette aphis was not only found to differ morphologically from **E. americana,** with which it had previously been confused, but in 1915,

Patch was able to prove that this latter species had a cycle entirely its own, between **Ulmus americana** and **Amelanchier.** Still another species of interest, **E. rileyi** Thomas, was shown by Patch's notes to remain on the bark of elm during the summer. This bark aphis, although producing winged forms, appears to dispense with a secondary host plant in America, in much the same way as the bark feeding **lanigera** on apple manages to dispense with the primary host plant in most parts of the world.

In bestowing a name on the rosette aphis, with a known migration to thorn, mountain ash, and apple, Patch, followed by Baker and Becker, was guided by the following indisputable facts; namely, that those specific characters of the antennae, that had served so successfully in separating the **Eriosomae,** failed to separate **lanigera** from **crataegi**; that apple was a host plant common to both; and that **lanigera,** 1802, had obvious priority over **crataegi,** 1887.

Baker, in his well known report, 1915, hesitated to place **crataegi** under the name of **lanigera,** until more was known of the former's biology in its natural environment. It was none the less inferred that **lanigera** was indigenous to America and in its native haunts alternated between elm and thorn, adopting apple when this was introduced. On this new host plant, **lanigera** acquired a new method of perpetuating itself by which it was able, in part, to throw off its dependence on elm. Thus emancipated, it contrived to establish itself in countries where **Ulmus americana** does not exist.

To what extent this modified existence on the adopted host plant in Eastern North America has affected the normal intercourse between native elm and native thorn is a matter that has not been sufficiently enquired into.

It would be interesting to know whether the aphis on thorn is gradually becoming independent of elm in Maine, Virginia, and Arkansas.

With such important information unavailable, it would serve no useful purpose to examine other theories that have been put forward during the last quarter of a century in support, or in refutation, of **lanigera's** elm connection in America. These are set out very clearly and concisely by Greenslade, 1936, who, in addition to presenting a survey of the extensive literature on **lanigera,** gives a digest of the numerous replies received by the East Malling Station, Kent, England, to a widely circulated questionnaire on this subject. Among sceptics, Greenslade cites Carl Borner, 1932, who maintains that **lanigera** confines itself to apple in America as elsewhere, and that the species which migrates to apple, mountain ash, and hawthorn, is **Eriosoma crataegi** Oestlund.

The life history of **lanigera** as studied in Virginia by Alwood, 1898, lends weight to the first part of Borner's contention, and recent observations in connection with the appearance of a woolly aphis of thorn in the Interior of British Columbia indicate in no uncertain manner that this aphis is **crataegi** and is distinct both taxonomically and biologically from **lanigera.**

The significance attaching to certain features of the life history of **crataegi** can best be appreciated by presenting a brief survey of the circumstances leading up to its discovery.

Eriosoma lanigera has been for more than twenty years a common, and at times a noxious pest in the irrigated orchards of the dry belt of British Columbia. Owing to its rapid increase in 1926-27, and accumulating evidence that **lanigera** was instrumental in spreading a cankered condition on the limbs of apple trees, an extensive study of the insect was undertaken in 1928. This has continued since, and has also embraced the study of other gall forming members of the **Aphidinae,** including the **Adelginae.**

In this wider field of research, both the recorded behaviour of **lanigera** in America, and in Europe, have their counterparts in the life history of some of the species studied, where parthenogenesis on the secondary host plant appears to be supplanting a sexual dependence on the primary host. Among species of the **Adelginae,** which like the **Eriosomae,** have the same primary host plant in common, similar difficulties in differentiating between species are encountered, but a much larger number of structures have come into use for taxonomic purposes in studying the **Adelginae** than have hitherto been deemed necessary for separating the **Eriosomae.** Where two insects have similar biologies, one character may be sufficient to prove two separate species, but where there is a wide difference in the biology of two insects, a large number of characters may have to be brought into use before identity can be satisfactorily established.

The first step in this prolonged study of **lanigera** was naturally an enquiry into probable host plants. Thorns are abundant in most parts of the Interior, but these native kinds are distinct from those in the east. No native elms exist west of the Rockies, but a number of these have been introduced, most of the older trees having been imported from Shenandoah, Iowa, in 1897. Both English and American elms are numerous in some localities, while one, or both species, are absent in others. There is nothing to indicate that the presence, or species, or proximity of elm, have any influence whatever on the extent or degree of infestation of apple by **lanigera.**

A failure to find rosettes on elm during 1928-1936, coupled with the complete freedom of the native thorns and mountain ash from woolly aphis attack, confirmed an opinion, very soon formed, that **lanigera** did

not follow, in British Columbia, the biological development claimed for it in the East.

In Vernon, alate sexuparae appear in the autumn as they do in Europe, and after an unusually mild winter, some of the hibernating forms developed into sexuparae in May, 1932, and deposited abnormal sexforms. Some of these had perfect and others partially developed rostra. Two viviparous alates and one pupal form were found in different years during the mid summer months, but in the fall, every effort to procure the sexes and egg on elm, by the sleeving in of numerous normal sexuparae, proved unsuccessful.

Due to many factors—among which may be cited better methods of control, the natural increase of predators as infestation reached its peak, and the successful dissemination and establishment of the parasite **Aphelinus mali** Hald.—there has been a marked decline in woolly aphis infestation since 1933. It has, indeed, become quite difficult to obtain material for study in the vicinity of the laboratory at Vernon.

In July, 1935, two small yet remarkable infestations, about three-quarters of a mile apart, were discovered on the wild thorn. One of these infestations was conveniently situated in the insectary yard, just a step from the laboratory. This yard is only about 30 feet square, yet manages to contain several young apple trees which, in previous years, had shown a decided susceptibility to attack by **lanigera.** On the east side, the yard is bounded by a thorn hedge. This, in turn, is flanked on the south by an apple tree, and on the north by an American elm. This elm is but one of many in the neighbourhood.

Thousands of alatae of **lanigera** have been sleeved in on this elm in the yard without procuring a rosette, and the same tree has been constantly visited from year to year to study the life history of **E. americana** which is well established between imported American elm and the native **Amelanchiers.**

The entire absence, during the last few years, of any sign of lanigera on the apples in the insectary yard did not permit this July infestation on thorn merely to be regarded as one of those rare escapes of **lanigera** to kindred host plants noted by Marchal in France. The time of the year, and the local absence of **lanigera,** strongly suggested a migratory aphis. Accordingly, this infestation was left unmolested until August, when a number of sexuparae were procured and sleeved in on the elm to test the truth of the above assumption.

In the following spring, several rosettes made their appearance not only on the elm in the yard but on others in the neighbourhood. The rosette aphis was observed in 1936 and 1937 to copy faithfully the development recorded in the East, and was found to agree in every detail with the characters described and depicted by Patch and others for

the rosette aphis during its sojourn on elm. The subsequent discrimination in selecting the summer host plant was not however in accordance with the behaviour of the migrant from rosette which in Maine, accepts apple readily.

During the past two years infestation had so increased that rosettes on American elm could be counted in hundreds in the spring of 1937. Infestation has been picked up on thorn a considerable distance from known elms, while thorns on vacant lots in close proximity to elm have been severely affected. During this rapid spread of the insect on elm and thorn, the apple trees in the yard and neighbourhood have remained entirely free from any woolly aphis attack. Strange to say, cage tests indicate that the rosette aphis has no inclination at present to go to apple. This, however, is no reason for presuming that it will not incidentally establish itself on apple in the future.

A curious, and precocious instinct for the normal host plant was displayed in one cage test, where in addition to thorn, the rosette aphis was offered Transcendent Crab, which variety is highly susceptible to **lanigera.** The crab was entirely neglected, the migrants, as in other tests, choosing to settle on the leaves of the thorn. There they deposited their yong which crawled away to settle on the base of the stem. In the test under consideration, a number of pupal forms prematurely left the drying up leaves of the rosette interned in the cage, and were found—not on the leaves of the thorn, the natural objective of the adult—but with their stylets inserted in the stem among the progeny of the migrant.

The migration from elm to the secondary host plant is much as complete as it is in the East. The migration from thorn to elm is likewise complete, whereas **lanigera's** migration from apple in the East is at best only partial. Not only has it been ascertained that **Crataegus columbiana,** and **C. douglasii,** show no sign of infestation until the migration from elm is well advanced, but it is proved, beyond doubt, that all the late generations on thorn develop wings. There are no apterae left on the secondary host plant (which are abundant in the case of **lanigera** on apple) to make an early infestation of thorn possible.

Should the migrants from elm adopt apple and mountain ash, besides thorn, as they do in the East, a complete return of their descendents to elm is to be anticipated in the fall. There are no grounds for believing that the adoption of other kindred host plants during the summer could, without some mutation occurring, alter fixed habits which are identical in character to those displayed by **americana** between elm and **Amelanchier.** Apple trees infested by elm migrants and also by **lanigera** would thus reveal a partial migration to elm as noted by Baker, 1912, in an extract of a letter published by Patch, 1916.

Dissections show that the alates that migrate to elm from thorn

contain a larger number of sexforms than those that stay on apple. This is remarked on by Schoene and Underhill, 1935. The males of the virile elm sexuparae outnumber the females more than two to one. The opposite is the case in the impotent sexuparae on apple. Experiment shows that the males of the elm-thorn aphis are born first, while under similar conditions, the females of the apple aphis are the first to be deposited.

Turning to an examination of structural differences, it has to be admitted that except for the greater proportional length of the male antennae of **crataegi,** there are no differences in these appendages that have specific value in other stages. There are other characters, however, that are not only sufficient to give **crataegi** specific standing, but in addition indicate that the relationship of these two aphides is not nearly as close as the study of the antennae alone would lead one to believe.

Fig. 1 shows at a glance a considerable difference in the size and shape of the waxglands, taken from the same area, of the same instar, of both species. The individual pores are alike in character in all the **Eriosomae** studied, but the arrangement of the pores is peculiar to different species. In **lanigera,** the pores are not arranged in an open circular ring, enclosing an extensive area, but are pressed together, so that their inner sides are nearly touching. This closed type of waxgland is specific for **Eriosoma lanigera** in British Columbia.

The open, ring-like nature of the waxglands of **crataegi** is constant throughout the descendents of the foundress on elm. This open, ring-like waxgland is depicted by Baker as typical of the viviparous female on apple, presumably derived from elm, and by Patch as typical of the second generation actually on elm.

Accompanying this difference in the arrangement of the waxpores, there is also a marked difference in the size and shape of the cornicles. Both **lanigera** and **ulmi** have small circular cornicles, while the larger oval cornicles are common to both **crataegi** and **americana.**

The above two characters are sufficient to separate the apterae of **lanigera** and **crataegi,** except in the early instars where cornicles are absent.

The differentiation between the sexuparae is more difficult, for the waxpores are vestigial in the winged forms, and only the difference in the cornicles remains. No one long accustomed to **lanigera's** variations, could fail to be conscious of something very different on first beholding the sexuparae of **crataegi** under the binocular. This difference is partly due to size, spread of wing, and a more delicate tracing of the wing veins. Colour, however, is the chief difference. Although colour can rarely be relied on for separating species, it is very constant for groups.

For example, when **crataegi, lanigera, ulmi,** and **americana,** are mounted side by side in gum chloral, which preserves and accentuates the natural colour, the abdomen and stigma of the forewing of crataegi are the same vivid green of **americana.** The abdomen of **lanigera** is the reddish hue of **ulmi,** and in both the latter alatae, the stigma is not green, but the same dull brown. The adult males of **crataegi** and **americana,** are also green, whereas, the males of **lanigera** and **ulmi** are yellow.

Structural differences in the wings of all the **Eriosomae** are slight, with some variation occurring in the same species. All have the single forked median of the forewing obsolete at its base, a character on which Hartig, 1841, erected his genus **Schizoneura,** which recently has been superseded by Leach's less constructive **Eriosoma,** 1818, which has priority.

One of the main characters, which Oestlund relied on in giving distinction to the thorn aphis, was that the median vein of the alate was not obsolete, but continued to its base. This feature is very constant in the alates taken on thorn, but is more apparent than real, the basal part of what was conceived to be the vein being tracheal. Newly emerged sexuparae of both **lanigera** and **americana** display this feature, which disappears as the wings become more mature. The alates of **crataegi** leave the thorn as soon as the wings are in a condition for flight. The alates of **lanigera** linger, and often feed on the apple, sometimes dropping the sexforms in the colonies of apterae. This difference in the maturity of the wings, accounts for this feature of the median noted by Oestlund as being constant in **crataegi** on thorn, and only occasional in **lanigera.**

As shown by the photographs of Patch, the curve of the radial sector of **crataegi** is slightly deflected downwards at the extremity, while in **lanigera** the curve usually continues on its upward course. The radial sector in both **lanigera** and **ulmi** is not inserted as close to the base of the stigma as is the case with **crataegi, americana,** and **rileyi.** This relative position of the radial sector to the base of the stigma is of interest, because Scudder contends that this particular character separates the ancient and modern aphides of the New World from those of the Old.

There are also a number of campaniform sensillae scattered along the thick subcosta between the base of the anal and the stigma. These are more numerous in **crataegi** than in **lanigera.** Similar sensillae are found in groups at the base of the wings of both species, and are singly represented on the distal segment of the tarsus and the second segment of the antennae. Two pairs of these sensillae are found on the trochanter and others are found on the femur. These sensillae are common to other families besides the **Eriosomae.**

A difference in the antennal lengths of the male has already been noted. The average length of 10 males of **crataegi** is .274 mm. as compared to Baker's measurements of .181 mm. for **lanigera** and .209 for **lanigera** in Vernon. This difference is most significant in segments III and IV. Baker's measurements and those in Vernon, show that the male and female antennae are much the same in length, whereas the male of **crataegi** has consistently longer antennae than the female, averaging .274 and .212 mm. respectively.

The only difference in the eggs of the two species is that the egg of **crataegi** both on elm and under artificial conditions is deposited with a covering of woolly excretion, while very little wool surrounds the egg of **lanigera.** The sexforms exude only a very small quantity of woolly material, the waxglands being vestigial, and the profuse covering of the egg is derived from a special, and hitherto unrecorded structure, appearing only in the adult oviparous female. This is one of a pair of perforated waxplates, shown in Fig. 2, occupying the position of the cornicles in the viviparous forms. These plates only appear after the last moult, at a time when the egg practically occupies the whole cavity of the body and thus obscures these structures. After the egg is deposited, the shrunken abdomen of the female can be pressed out in mounting, and these perforated waxplates, yellow in colour, are brought into view. Although more prominent in **crataegi,** these plates are present and function to some extent in **lanigera.** They are also observed to be vestigial in **americana** where the eggs are entirely destitute of covering.

In many respects **lanigera** might be morphologically regarded as a degenerate off-shoot of **crataegi,** but there is one character, that has considerable specific value, which debars the acceptance of such a view. In all its five stages, the female of **lanigera** has a rudimentary labium, represented by a crescent-shaped thickening of the cuticle on which are clustered four or five hairs on tubercles. Hence, the mouthparts of the female are not so vestigial as those of the female of **crataegi,** where hairs and vestiges of a labium are entirely wanting.

It will, nevertheless, be evident that the above morphological differences are not as pronounced as biological differences. Had **crataegi** been as general, in 1928, as it is likely to become in the near future, there can be little doubt that rosettes on elm would have confused the issue of early investigations.

The late arrival of **crataegi,** probably from some source where the habit of going to apple had not, or could not, be acquired, together with the local absence of **lanigera** in the neighbourhood, as a disturbing factor when **crataegi** was discovered, have all been advantages denied to other workers who have assisted in clearing up a highly contraversial question of long standing.

Although corroboration of the main facts in this paper must be awaited from the East before this vexed question of **lanigera's** connection with the elm is finally settled, there is one general fact beyond dispute. This is, that the only part of the world where **lanigera** is said to migrate to elm is North America, where a definite migration is proved to exist between the native elms and thorns by a woolly aphis.

This aphis in British Columbia is proved to be as independent of apple, as **lanigera** has been proved to be independent of elm in every part of the world except North America, east of the Rockies.

On the basis of the antennae, a remarkable and perhaps an unique case of resemblance exists between two species that are separable by characters which do not point to a close relationship.

There is every assurance that the species studied on apple since 1928 in Vernon, British Columbia, is **Eriosoma lanigera** (Haus.) and equal assurance that the recently introduced woolly aphis on **thorn,** alternating between elm and thorn, is not **lanigera.** There is no option but to consider the latter aphis to be **Eriosoma crataegi** (Oestlund) and therefore distinct.

Publications Directly Referred to in This Paper

1890,	Scudder, S. H.	Tertiary Insects of North America.
1898,	Alwood, W. B.	Notes on the Life History of the Woolly Aphis of Apple. Abstract, Proc. Ass'n. Ec. Entomologist.
1913,	Patch, E. M.	Woolly Aphis of the Apple, Bull. 217, Me. Agr. Exp. Sta.
1913,	Davidson, J.	Structure and Biology of **Schizoneura** lanigera, Quart. J. Micr. Sci. 58.
1915,	Baker, A. C.	Report 101, U. S. Dept. Agr.
1915,	Patch, E. M.	Woolly Aphid of Elm and June-berry, Bull. 241, Me. Agr. Exp. Sta.
1915,	Gillette, C. P. & Bragg, L. C.	Notes on Some Colorado Aphids Having Alternate Food Habits, Jour. Econ. Ent., 8.
1916,	Patch, E. M.	Elm Leaf Rosette and Woolly Aphid of Apple, Bull. 256, Me. Agr. Exp. Sta.
1918,	Becker, G. G.	The Apple Woolly Aphis, Bull. 154, Ark. Agr. Exp. Sta.

1928, Marchal, P. Étude Biologique et Morphologique du Puceron Lanigère du Pommier, Ann. Apiphyte 14.

1929, Venables, E. P. Observations on the Woolly Aphis of Apple, Proc. Ent. Soc., B. C.

1932, Börner, C. Apfel-und Dorn-Blutlans. Anz. Schädlingsk.

1935, Schoene, W. J. & Underhill, G. W. Life History and Migration of the Woolly Aphis of Apple. Tech. Bull. 57. Va. Agr. Exp. Sta.

1936, Greenslade, R. M. Tech. Commun. No. 8, East Malling, Kent.

FURTHER NOTES ON THE WOOLLY APHIS PARASITE **Aphelinus mali** Hald.

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In 1931, a short paper was presented before this Society, dealing with the introduction of **Aphelinus mali** Haldman. into the Okanagan Valley. No information was available at that time regarding the effect of the parasite on the seasonal abundance of the woolly aphis, **Eriosoma lanigera** Hausman, as the parasite had only been introduced two years previously.

During the four years following its introduction, the parasite was reared in large numbers on caged apple trees at various points throughout the Okanagan, between Vernon and Oliver, and from these centres its further spread was attained by various measures, some of which may be briefly mentioned.

This parasite, in the adult stage, is a very small Hymenopterous insect which becomes active when disturbed, but usually prefers to crawl slowly over the leaves in search of its host, or to proceed by short hops from twig to twig, rather than to indulge in long flights. They were found most commonly on the lower sides of the leaves rather than on the upper surface, and most of those collected were taken from beneath leaves on the lower branches. Various means were tested for collecting the adult parasites in the cages and for transporting them to the locality in which they were to be released.

The use of a suction apparatus, attached to a glass vial and operated by the mouth, proved to be satisfactory for capturing the insects on the leaves and also on the walls of the cage. Tests were also made in which small two year old trees were enclosed in drop cages of cotton, which could be removed, and replaced by a tight, dark box with glass vials inserted in the sides to capture the insects. Although attracted to the light, they were not captured in sufficient numbers to warrant the general adoption of this method. It might be practical under certain circumstances.

Owing to the abundance of the parasites in the larger cages, and the vast numbers of aphids on the water sprouts and spurs which contained both larval and pupal parasites, the most satisfactory plan was to cut sections of twigs and sprouts heavily infested with parasitized aphids and to stand these in a tight tin box with damp sand. Large consignments could be collected in this way, and any live aphids present continued to feed, and the parasites to develop, for several

days after the cuttings had been taken. These infested shoots could be placed in the trees it was desired to infest and successful inoculations could generally be secured. The long distances between the breeding cages in the different districts and the amount of travelling necessary to take care of all the material, made it difficult to keep up with the emergence of the parasite in all the cages during the season, and in order to avoid waste of material, a section of the cotton wall of each cage was replaced with wire netting through which the parasites could escape to nearby trees.

Distribution of cuttings from the cages was also undertaken by the local Provincial Field Inspectors in the district where the cages were operated.

The comparative abundance and spread of **Aphelinus mali** has been watched carefully and it has been found to occur in practically every section of the Valley, and may be observed in almost every orchard. The very wide distribution of the insect from the original points of liberation is remarkable. In two seasons it was found to have crossed Okanagan Lake, a distance of about two miles. At Kelowna, the insect is common three miles from the nearest orchard in which it was released four years ago, and at Penticton, it has been recovered at long distances from the points of release.

The woolly aphis has not occurred in outbreak form since **Aphelinus mali** was introduced, but owing to the lack of information regarding its seasonal abundance over a period of years, we cannot as yet place the scarcity of the pest to the credit of **Aphelinus mali.** We know that outbreaks of woolly aphis have occurred periodically in the past, and it is to be regretted that we have no data by which to compare outbreak conditions over a longer period. Such information might help to a better understanding of the actual influence of **Aphelinus mali** on the comparative prevalence of its host.

In the cages, the parasite never actually destroyed all of the aphids, and reinfestation occurred each year in all cages. Conditions affecting the abundance of the aphis seem also to affect the prevalence of the parasite. At Penticton, in one of the cages erected when the general woolly aphis infestation was on the decline, the aphis failed to develop to any extent in the cage; although many colonies were introduced from time to time. **Aphelinus mali,** although placed in this cage in some numbers, never produced a strong infestation at any time and both parasite and host remained at a fairly low ebb compared to other cages in previous years, when aphis infestation was heavy.

Whilst this paper deals with general conditions rather than detailed observations, a few notes on the development and activity of this parasite may be of interest. The presence of the larva of **Aphelinus mali**

within its host is first indicated by the body of the aphid becoming swollen and of a pale yellowish colour. Up to this time, the aphid continues to exude honey dew and to moult, but soon after the yellow colour is assumed, the insect dies, and the skin becomes black and brittle, covered to some extent with the woolly powder produced in life. The body of the aphis may turn black within eight to ten days following oviposition by the parasite. In experiments to determine whether the parasitism of the young aphids prevented their reproduction later, it was found that in the case of aphids in the second instar, death occurred in from nine to thirteen days, and that no reproduction occurred.

Aphelinus mali appears to be of particular value in the early summer at the time of the migration of its host to the terminal growth, where they settle down in axils of the leaves above the new buds. The presence of the aphids in this position is easily overlooked, although 75% of the leaf axils may harbour from one to three insects or more. In a series of counts, it has been shown that over 60% of these isolated and incipient colonies may be destroyed by **Aphelinus mali** and later infestation thereby checked.

An examination was made of forty colonies of woolly aphis to determine the percentage of colonies attacked by the parasite, and the number of individual aphids destroyed in each colony, with the following results:-

Of the forty small colonies, thirty-three had been attacked and contained black aphids. In these forty colonies, there were 126 insects, of which 53 had been killed by the parasite. This does not take into account those insects containing the eggs or larvae of **Aphelinus.** Six of these colonies had no live aphids present and these may have been destroyed by predators, as no steps were taken to exclude either **Coccinellids** or **Syrphid** larvae.

In order to understand what influence **Aphelinus mali** will exert on woolly aphis outbreaks in the future, a better understanding of the periodical cycles of its host is necessary. Information of this kind is lacking in the case of some of our commonest insect pests and should be remedied by systematic observations each season, rather than depending on memory, or upon records compiled during the winter months, long after the insects concerned have disappeared.

FURTHER NOTES ON THE FLEAS OF BRITISH COLUMBIA

By G. J. Spencer
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Section A. New Species.

In the Proceedings of our Society for 1935, published Feb. 1936, I gave a list of 61 spp. of Fleas, compiled from all records but mainly from Rothschild and Jordan's lists and from the collections at the University and at Kamloops, which were identified for me by Dr. Wagner of Belgrade; two species in the list were new.

Since that time, Dr. J. Wagner has published a couple of papers on our fleas.

In the Canadian Entomologist, Vol. **68** p. 193 for September 1936, he gave full notes on 61 sp. of fleas of British Columbia and described 4 new species and one new variety, as follows:

In my list.—

Megarthroglossus similis Wag.
M. spenceri Wag.
M. pygmaeus Wag.

Not in my list.—

Thrassis spenceri Wag.

Megarthroglossus longispinus Baker var **exsecatus** Wag. var. nov

There has just come to hand another publication, "Neue Nordamerikänische Floharten" in Zeitschrift fur Parasiten Kunde, 8 Band, 6 Heft, 26 Sept. 1936, in which he again mentions **Thrassis spenceri** but describes four more new species from my collections at the University, as follows:

Ceratophyllus petrochelidoni Wag.
which I took off eave swallows in the Chilcotin and at Kamloops.

Megarthroglossus adversus Wag.
from a white-footed mouse (**Peromysus**) collected at the University.

Neopsylla scapani Wag.
from Schaffer's Mole, Vancouver.

Nycteridopsylla vancouverensis.
from silver-haired bat taken at the University.

Of all these 9 new species, the types of five have been deposited in the Canadian National collection and the other four will soon be sent there. Paratypes, when indicated, are at the University.

I am extremely indebted to Dr. Wagner for naming this material for me and for his generosity in returning to me all the types and so much of my material. In fact, it is only where species are represented by an abundance of material, that he has kept any specimens for his own collection.

Section B. Note on Fleas in Vancouver Residences.

During the past year, I have received many more records of cat and dog (chiefly cat) fleas infesting residences in the city. In nearly every case, the fleas were associated with sawdust used for fuel. In some cases, cats or dogs, or both were present; in others, no animals were present at all and in my own house, where an outbreak occurred, there was no sawdust and the cats were there for only the month of June.

Except for one case, where the bathroom was concerned, and where flea larvae were common on the floor especially under the bathtub, the outbreaks have all occurred in basements and have spread from there to the living rooms.

I have at last got definite proof—for which I have been looking for two years—that the fleas have actually been brought into a previously uninfested house, in the sawdust. They appeared within a few hours of the sawdust being brought in. This means that the fuel must have been infested in the warehouses or mill heaps.

During the past three years, I have carefully watched eight cats and one dog in sawdust-burning homes and in no case do the animals bed down in the sawdust. They play over it and use it as a toilet, but they never lie in it. It is in the margins of the heaps that fleas flourish, so their eggs must drop off the hosts as they play in the sawdust, or spread from the animals' beds.

The summer climate of Vancouver seems especially suitable for fleas and they can flourish in any home where a little dust accumulates, provided it is sufficiently damp. In fact, they can flourish in any basement and it becomes necessary to consider the possibility of an outbreak in **any** home, especially if domestic animals are present. The presence of sawdust provides the necessary dampness.

Suggested Control Measures.

Last year I mentioned aids to control—freeing animals of their

fleas with a little fresh derris powder, cleaning up and burning all dust from animals' beds and the floor all around, and treating the edges of sawdust heaps with a thin sprinkling of derris powder.

At this time, I would recommend two new control measures: 1. Spraying the basement thoroughly with any fly spray and then sprinkling a thin layer of fresh cedar sawdust all over the basement floor and around the sawdust bin. There are several cedar mills in Vancouver, but cedar sawdust is so bulky that is is not used for fuel, although its heat value is equal to that of the best fir sawdust. A few sacks of cedar sawdust can readily be obtained or can be ordered from a mill at the same time as the other fuel.

2. Fleas flourish best in closed-up **damp** basements. They invariably form a plague when houses have been shut up all summer and have become damp. Where fleas occur, people have a tendency to shut their basements closely and use the upper part of the house. Just the reverse should be done—open the doors and windows and let the basement dry out as far as possible—let the wind sweep through it.

When people go away for summer holidays, it would pay to open windows at opposite ends of the basement, nail heavy fox-wire netting or close chicken wire netting of ½ inch mesh across the frame, and a second barrier of common wire mosquito netting. The heavy wire will keep out all animals and the mosquito netting, all insects, and the current of dry summer air through the basement will dry out the floor and the edges of the sawdust bin and will go a long way to killing off all fleas (and sowbugs) and preventing their breeding.

ECTOPARASITES OF BIRDS AND MAMMALS OF BRITISH COLUMBIA

II. A Preliminary list of the Pupipara, Louse Flies.

By G. J. Spencer
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These remarkable and in some cases degenerate flies, are parasitic upon birds and mammals, where most of them move with easy speed through feathers and fur or hair. It is supposed that both sexes suck blood from their hosts, since both have protrusible piercing mouth parts. The bodies are usually flat and leathery and the legs are provided with strong claws; some are always wingless and slow-moving like the sheep-tick, while others, especially those on birds, are winged for flying from host to host. Some shed these wings at a fracture point close to the base soon after finding a host, while the bird parasites retain their wings throughout life. All, except the sheep tick which never has wings, have halteres or balancers on the metathorax.

The reproduction of these insects is unusual, in that the female produces a full-grown larva which has been nourished in a uterus by specially developed accessory glands, and either deposits the larva in the nest of the host, where it pupates very shortly, or extrudes it partially from a pouch, where it pupates almost immediately and the puparium is carried around by the female, often until the young fly emerges. Occasionally, a fly may be found carrying around an empty pupal case from which its offspring has recently emerged; this habit is especially true of our species on deer.

Amongst the Diptera, this viviparous form of reproduction occurs only amongst these louse flies and the tse-tse flies.

The following notes are based upon the collections which I have accumulated at the University and upon observations in the field. Further details of the louse flies upon deer are being published in a separate paper "The Ectoparasites of Deer in British Columbia".

Acknowledgements.

I am deeply indebted to Dr. Joseph Bequaert, of Harvard School of Tropical Medicine, who identified my preliminary collections and thus enabled me to cope with later collections. I am also greatly indebted to the following collectors in this Province who have supplied me with material: Messrs. E. R. Buckell, I. McTaggart Cowan, K. Racey and especially the late R. A. Cumming who developed a novel technique for collecting these flies. Shortly before his untimely death last sum-

mer, Mr. Cumming gave me permission to publish his methods, which I shall describe very shortly.

The fact that winged louse flies quickly leave their fallen hosts is well known to anybody who has ever collected them, and this brings up some interesting points as to why they do. It is conceivable that if the bird host was shot and left lying, without being disturbed at all, the flies would leave it as soon as it commenced to cool, which would not occur for at least a few minutes. On the other hand, if the host is killed and picked up almost immediately, it is possible that something in the unnatural position, or the disturbance of the feathers, might cause the flies to leave. That it is not necessarily due to being alarmed at the sight of a strange object (man) is shown by my experience with a fly on a red-tailed hawk. One evening at dusk I fired with a .22 rifle at a small object which was on the ground, moving amongst dense grass and flowers in an upland meadow, and on going up to see what it was, I was surprised to find a bird (instead of, as I had supposed, a wood chuck) sitting with its wings spread as if ready to take off. Even as I approached and was still a few feet away, I saw a large louse fly come up through the secondaries of the left wing and fly off. Keeping clear of beak and talons, I looked the bird over very carefully for another fly and for **Mallophaga**. Finding nothing, I stood up and the hawk promptly flew away, perched for a few minutes on a stag-headed aspen near by and then flew again, soaring out of sight. There was no trace of injury to the bird, and the fly left before I touched it, so one cannot attribute its alarm to the smell of blood or to any unusual disturbance in the feathers of its host.

Winged and broken-winged flies on deer, however, do not leave their hosts at all, but die among the hairs. I have taken some alive and active eleven days after the deer was shot (in November); most flies from this deer died within a few minutes of being removed from the hide, although a few of both sexes survived for nearly twenty minutes in methanol.

One species of louse fly locally frequents a number of small passerine birds, especially robins which so often become a pest around cherry trees in late summer. Mr. Cumming soon found that the flies leave within a few seconds after their hosts have been shot, so he put out about a score of quart "gem" jars under his cherry trees, shot the birds with a collecting gun, and immediately they fell, pounced on them and shoved them into the nearest jar, which he at once covered with cheese cloth held in place with rubber bands. The flies would leave the birds and, in endeavoring to escape, would work their way through the cheese cloth, thus giving him time to pick them off into a killing jar. He assured me that it was necessary to shoot the birds so that they fell almost directly into the jars—so soon would the flies leave

their dead hosts. All my records from robins were supplied by Mr. Cumming who collected them in this way.

All this means that a collector of these flies must pounce on all birds he shoots, especially birds of prey and game birds, and immediately drop them into a net or bag, if he expects to collect all flies that may be on them.

Distribution in British Columbia.

The Order Pupipara contains four families whose members have very restricted habits.

1. The Family **Braulidae** contains only one genus; one species **Braula caeca** Reav. occurs in Europe on the queens and drones of honey bees, and the other, **B. kohli,** occurs on a wild bee in the Belgian Congo. As far as I can determine, it has never been reported in Canada and but rarely in the United States and then probably on bees imported from Europe. The family is uncertainly placed at present, on account of certain conflicting features in the anatomy and habits.

2. The Family **Nycteribiidae** contains 5 genera and some 50 species, of which 8 species occur in North and South America and 3 of the 8 in California. All recorded species are wingless and occur on bats. They are long-legged insects, with the small head doubled back in a groove on the dorsal aspect of the thorax. So far, I have only one record from this Province, **Basilia forcipata** Ferris, (male) taken by the late Kenneth Auden off a bat from near Aspen Grove, in the Nicola region, in 1924. The species of bat is not recorded, but since both **Myotis** and **Eptesicus** occur near Aspen Grove, I presume that the fly must have come from a species of one of these genera.

3. The third Family is the **Streblidae,** of 13 genera but few species. They are both winged and wingless, almost all parasitic upon bats and mostly tropical. Two species of the genus **Strebla** occur in California, but so far, I have only one record from British Columbia, that of a small winged species of **Trichobius** taken from an undetermined bat found in a mine shaft in the Okanagan Valley by Mr. A. A. Dennys and given to me by Mr. E. R. Buckell.

I have examined a fair number of bats in the last ten years but have never found a member of either the **Nycteribiidae** or **Streblidae.**

4. The fourth Family is the **Hippoboscidae,** of some 18 genera and a considerable number of species, distributed all over the world on birds and mammals. My collections consist of 7 genera and 9 species from this Province and many specimens of **Hippobosca longipennis** F. (= capensis v. Olf:) from India, off dogs and cattle.

The British Columbia Species of Hippoboscidae

1. **Melophagus ovinus** (L.). This is the ubiquitous sheep tick, distributed wherever sheep are kept. It is an entirely wingless insect, without halteres, flat and slow-moving. Males are smaller than females, sometimes very small. My experience is that both sexes die within a few minutes of being removed from their hosts.

2. **Lipoptena depressa** (Say) has been taken off the coast deer from several points on Vancouver Island such as Sooke Lake, Comox and Campbell River and from Lasqueti Island in the Gulf. In one collection from a deer shot in November at Campbell River, I took 51 females, of which several were carrying larvae in various stages of development and extrusion, and 30 males. Most of them had broken off their wings when collected. On the same deer was a solitary male of the next species. Only the head and generous scalp of the deer were available so the animal must have been heavily infested, perhaps with both species.

3. **Lipoptena ferrisi** J. Beq. (= **L. subulata** Coq.) (Dr. Bequaert informs me that this is not **subulata,** as Ferris called it, so he has renamed it **ferrisi.**) I have a number of collections from the Mule deer of the Interior and on two occasions, solitary specimens amongst **L. depressa** from Vancouver Island. Of one collection of 7 males and 4 females, taken from a deer at Pemberton Meadows in November, one of the females contained a young larva.

The distribution of these two species is interesting—**depressa** being mostly on the Coast Islands and **ferrisi** in the Interior. When both species occur on the same animal on the coast, **depressa** greatly outnumbers **ferrisi.** One record of both species on a coast deer is from Pemberton, on the mainland, but still in the coastal region.

I have treated of these and other parasites of deer (except ticks) in a separate paper, to be published shortly.

4. **Ornithomyia avicularia** L. I have only one collection of one individual of this world-wide species, taken off Steller's Blue Jay at Tofino, on the west coast of Vancouver Island.

5. **Ornithomyia fringillina** Curtis (= **O. chloropus** Bergroth)

This is the most frequently-occurring species in British Columbia. Its distribution, according to my collections, is summed up in the following table:

Records of Ornithomyia fringillina Curtis in British Columbia

Locality	A.O.U.		Month	No. per Host
Chezakut Lake	54	Ring-billed Gull	August	1 fly
Lytton	297	Blue grouse, Juvenile	September	1 fly
Lone Butte	297	Blue grouse (?)	October	1 fly
Wentworth	299	Franklin's grouse	October	1 fly
Salmon Arm	332	Sharp-shinned hawk	August	1 fly
Jesmond		"Hawk" sp. undet.	August	3 flies*
Prob. Vancouver	366	Long-eared owl	February	1 fly, carrying pupa
Pitt River	379	Coast Pygmy owl	September	1 fly
Vancouver	394	Gairdner's Downey Wd-pecker	June	1 fly
Vancouver	413	Red-shafted flicker	November	1 fly
Vancouver	493	Chinese starling	14 August	1 fly
Vancouver	493	Chinese starling	28 August	1 female†
Vancouver	567a.	Oregon Junco	July	1 fly
Vancouver	581	Rusty Song sparrow	June	1 fly
Vancouver	583	Lincoln's sparrow	November	1 fly
Vancouver	596	Black-headed grosbeck	July	1 fly
Vancouver	646	Lutescent warbler	June	1 fly
Vancouver		English sparrow	July	1 fly
Vancouver	758	Russet-backed thrush	June, August, September	1 fly each See **Note 3**
Vancouver	759	Hermit thrush	October	1 fly
Vancouver	761	Robin and North-west Robin	June, July & August	17 records from Robin **Note 4**

* Note 1. † Note 2.

Notes on above Records.

Note 1.

The description of the hawk shot at Jesmond, (1937) in the Big Bar country west of Clinton, fitted best the Red Tail, but my informant was not sure. The bird carried three flies; one of these, a female, carried, on the posterior tip of the abdomen, a dense tuft of eggs of the mite **Myialges.** One mite is clearly visible at the edge of the egg mass and there may be another, or several mites, in the middle of the mass.

Note 2.

The fly taken off Chinese starling on August 28 (1936) was carrying several specimens of the curious mite **Myialges** and clumps of their eggs, on the dorsum of the abdomen. Dr. Bequaert kindly named the

genus for me when calling my attention to their presence on the fly, but the specimens do not agree closely with Ferris' figures of **M. Caulatoon** which they resemble rather than **M. anchora,** except that the four anal bristles and the tarsal bristles are much longer in my specimens and the tips of the legs are provided with suckers rather than with chelate or bifurcate bristles.

Note 3.

The fly taken off Russet-backed thrush in June was carrying five specimens of the Mallophagan louse, **Degeeriella interposita** Kellogg. The lice were named for Dr. Bequaert, to whom I sent the fly, by Mr. Harold Peters, recently of Washington, D. C. I am grateful to Mr. Peters for this identification.

Note 4.

I have seventeen records of this fly off Robin and Northwest Robin during June, July and August, all taken by Mr. R. A. Cumming in South Vancouver, when he was making a special effort to get lice off robins for the United States National Museum. Of these seventeen birds, twelve had one fly apiece, three had two apiece and two had three flies apiece.

It is interesting to note again the distribution of this fly **O. fringillina** on its various hosts. One is a gull, two are grouse or ground game birds, two are hawks, two are owls, two are birds that nest in holes in trees and there are ten species of perching birds; in all, nineteen species and one variety. Moreover, the one record taken early in the year, the Long-eared owl shot in February, is the only one that has given evidence of the flies breeding, though the puparium being carried round by the fly was empty, showing that breeding had passed, at least in this instance. This forms a contrast to the flies found on deer, which seem to breed, or at least to produce their larvae, in late autumn and early winter.

6. **Ornithoctona erythrocephala** (Leach) taken off a Peregrine falcon in summer, at Osoyoos.

7. **Ornithoica confluenta** (Say) (= **O. promiscua**) taken from Rusty song sparrow in August and from Steller's Jay in September.

8. **Olfersia fumipennis** Sahlb taken from Lincolns sparrow and from Lutescent warbler in June, at Vancouver. Also from an "unknown host" at Kamloops in September.

9. **Lynchia nigra** Perty, from a Sparrow Hawk (grasshopper hawk) in April at Huntingdon.

References.

Bequaert, J. 1935-37. Correspondence.

Brues and Melander. 1932. Classification of Insects. Harvard Museum.
Comstock, J. H. 1924. An Introduction to Entomology. Ithaca, N. Y.
Curran, C. H. 1934. Families and Genera of N. A. Diptera. Am. Mus. Nat. Hist.
Essig, E. O. 1926. Insects of Western North America. Macmillan & Co.
Ferris, G. F. 1916. Ent. News. Vol **27**, No. 10 December.
Ferris, G. F. 1924. Ent. News. Vol **35**, No. 6 June.
Ferris, G. F. 1928. The Genus Myialges. Ent. News. Vol XXXIX, No. 5.
Imms, A. D. 1925. Textbook of Entomology. Methuen & Co.
Sharp, D. 1899. Insects, Pt. II. Macmillan & Co.
Williston, S. 1908. Manual of North American Diptera. III Ed.

THE IMPORTANCE OF PHENOLOGICAL NOTATIONS DURING INSECT ECOLOGICAL STUDIES

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During the past two years the Dominion Entomological Laboratory at Kamloops has been accompanying its tick and biting fly field observations with brief notes on floral life and development at the particular area under study. The increasingly significant value of this correlation has encouraged the laboratory to pay a still greater attention to the floral distribution and advancement throughout all areas within its scope.

The nature and value of phenological recordings are outlined herein, since it is possible that such studies might also be of aid to phases of work carried out by other British Columbia laboratories and, if this should be so, a co-operative recording from various parts of the province would serve to accumulate a more accurate and comprehensive mass of data than could be collected by any single laboratory.

The value of notes on floral species and their development in a given area under observation may be discussed under two headings.

Firstly, the inaccuracy of dates, and their often misleading significance, has probably been realized by all field entomologists. Due to ever-differing combinations of rainfall, temperature, wind and other climatic factors, it is very seldom that we have two seasons of similar advancement, thus rendering useless the recording of a certain specimen as being taken on July 15th, for example, with hopes of taking more during the following year on the same date. As an instance of this, streams have been noted by the writer to breed consecutively, several distinct species of blackfly throughout a season, and it was his misfortune only last season to miss entirely a certain described early stage, that he had observed in the same locality but a few days later the previous year.

Ticks are very sensitive to weather conditions, and through their united response to certain factors, have been known to cause severe outbreaks of tick paralysis. Owing to the variation in weather conditions, however, their activity at a certain date one year cannot be predicted for a similar calendar date in the following year.

It seems, then, that we need some means of recording the average effect of all the changing weather conditions. Vegetation appears to be the only and, fortunately, the most suitable form of indicator for this purpose. It is believed that by noting the development of a series of some twelve or more common plants, either by leaf, flower or berry,

a series of climatic periods can be established that can be duplicated during any following year; it is very reasonable to expect that these periods will always be accompanied by a similar insect fauna and development in any set locality.

Secondly, it should be possible, through the aid of the delicate responses of plant life to climatic conditions, to establish type areas in which we may reasonably expect to find a certain insect fauna. Such areas, of course, may be micro- or macro-climatic in nature, and may be separated by a few feet or hundreds of miles. Thus, two or more areas that are found to include a common typical set of plants would probably yield a particular species of insect, common only to the certain primary climatic and secondary vegetative factors therein exhibited.

This second phase of study may not be as accurate and of as much value as the first; nevertheless, it bears many interesting speculations and does fit in very nicely with the previously-mentioned phenological recordings.

The system of referring to the floral development as indicators of time and locality is not new and has been used in Canada in connection with the preparation of spray calendars and similar work. Its application to entomology where the insect under study is not directly related to the plant development is however, I believe, still a matter to be given trial, and in consequence is a procedure that is open for criticism and suggestions. Observations of sets of plants common to the district could be recorded on special mimeographed sheets; these notes, in the active spring months, could be made every week, or even more often. In all cases, the greater the number of plants recorded, the more accurate will be the date or area indicated.

In dealing with type areas, discretion should be used in choosing plants or trees that are not too rare, and yet are not of such general distribution that they will overlap on adjoining areas. The species should preferably be familiar to the layman and free from similar or confusing forms.

Biological Calendar

1937 June	1st-5th	6th-10th	11th-15th	16th-20th	21st-25th	26th-30th
Floral notes:	Rose-bud—	bud+	blossom	blossom+	blos-som++	petals fallen.
	Black-berry	green	red-green	red—	red+	ripe— —
	Thimble-berry	ripe++	Salmon-berry	red+	ripe	ripe+
	Cherries					
Insect notes:	Notes on abundance of various species, economic and otherwise.					
Rainfall since previous date:	Slight showers, high. humidity					
Average temp.:	75° F.					
Sunshine:	Cloudy					

SOME NOTES ON THE PERIODICITIES OF CERTAIN INSECTS IN RELATION TO THE SUN SPOT CYCLE

By Hector A. Richmond (Junior Entomologist)
Dominion Entomological Laboratory, Vernon, B.C.

This paper is but a brief summary of some of the known facts regarding sun spots and a comparison of some of our insect periodicities with those of the sun spot cycle.

Although astronomical observations were recorded by the Chinese as far back as 2136 B.C., (Chambers 1909) the first authentic record of a sun spot is dated 188 A.D.

The nature of sun spots has been described by Dr. DeLury of the Dominion Observatory as whirling storms on the sun, much like a cyclone on the earth. Some of these are as large as our earth, others ten times as large. A spot the size of our earth, however, in comparison to the sun, would be no more than a trivial blemish on the solar disc. The centrifugal force of the whorl decreases the pressure at the centre and slightly cools the hot gas, giving it a darker centre. These spots have long been known to vary in number from year to year. Statistics procured over a long period of time show that they reach a maximum in number periodically from 9 to 14 years with an average cycle of 11.5 years. Since the sun is fundamentally responsible for our weather, it is plausible that the type of weather we experience should vary with the sun's condition. Data from Australian rock deposits 200 million years old, layers of clay deposited each spring for thousands of years, growth rings in trees in California and Arizona, all indicate that the sun has been following this regular cycle with varying degrees of intensity all that time.

Sun spots are, apparently, indications that the sun is undergoing an increased activity and that the unspotted area is giving off more heat than usual. It is, therefore, the condition of the sun, and not the spots themselves, that produces changed conditions on the earth during sun spot years.

Recent discoveries show that during sun spot years the area of the sun surrounding these spots is higher in solar atmosphere and that it is emitting a larger amount of ultra-violet light, which is frequently 75 percent greater and sometimes double when spots are numerous than when scarce. Sun spot years are therefore sun-burn years. Ultra violet light is known to liberate electrons from gases of low pressure, and this is what apparently happens to the upper atmosphere of the earth, which in turn becomes electrified during maximum sun spot years. This causes disturbances in various electromagnetic phenomena

and is evidenced by auroral displays and disturbances in terrestrial magnetism, telegraphy, radio, etc. Further, an electrification of the atmosphere results in the formation of ozone which exerts an absorption of solar radiation. It also induces the formation of cloudiness where water vapor is present.

Generally speaking, cloudiness and sun spots vary directly, whereas temperatures vary inversely. Hence, maximum sunspot years are accompanied by a maximum of clouds and a minimum of mean temperatures; while minimum sun spot years are accompanied by higher temperatures and greater transparency of the atmosphere. St. John's, Newfoundland, for example experiences a 20 percent greater rainfall during years of maximum sun spots. On the other hand, there are exceptions to this general rule. During minimum sun spot years, the greater transparency of the atmosphere and higher temperatures produce a greater evaporation on coastal points and this frequently precipitates inland. Thus Edmonton shows as much as 50 percent greater rainfall during the minimum years than at the maximum of sun spots. The greater atmospheric transparency of minimum sun spot years results in more rapidly rising air currents and quicker evaporation, thus producing more thunderstorms. Toronto, for example, shows 30 percent more thunderstorms during the minimum sun spot years.

In general, we may say that the sun spot cycle is accompanied by variations in the sunlight received, electromagnetic conditions, chemical compounds, and transparency of the atmosphere, temperature, cloudiness and precipitation. It would be logical, therefore, to look for some variation in the condition of life in general, in accordance with fluctuations of the physical elements by which they are controlled. The periodicities of certain insects and diseases are definitely correlated with weather, but records correlating life in general with the sun spot cycle are all too scarce. Possibilities in this direction are suggested by a study of grasshopper outbreaks.

One of the first attempts to correlate the grasshopper cycle with sun spots was made by A. H. Swinton in England in 1878. Criddle, (1932) published a homogeneous record of grasshoppers, grouse, and rabbits recorded in Manitoba between the years 1895-1929. The relation between their abundance and sun spots was shown graphically and in all cases, their numbers varied directly with the sun spots.

In considering the grasshoppers, Criddle mentioned that grasshoppers are probably kept in bounds by natural enemies and meteorological factors, but one would not expect to find grasshoppers subject to both at the same time, for weather adverse to grasshoppers probably would be detrimental to their natural enemies. In Manitoba, the higher temperatures, early spring and intermittent thundershowers accompanying the minimum sun spot period seemed most beneficial to the

grasshopper population. This condition, he found, occurred during thirty-two grasshopper outbreaks.

In an analysis of conditions as recorded in British Columbia during the past outbreaks, dating from 1889 to 1934, a rather striking similarity is shown, particularly in the Nicola country, as illustrated in the accompanying graph. The maximum outbreaks, apparently, have accompanied the sun spot minimum. Since these early records are only approximate, the fact that the peak occurs a year before or after the minimum is of little consequence. Further, although a slight increase is shown for 1906, near a sun spot maximum, the record for this year is dubious, and is based on the memory of certain inhabitants. There was no real epidemic that year.

Records from the Chilcotin country show a marked regularity, but at a different phase of the sun spot cycle than in the Nicola. An examination of the graph shows that the maximum years of grasshopper outbreaks occur, in a general way, between the maximum and minimum sun spot years, with the exception of the years between 1913-17 and the present outbreak. Such variations, however, might be the result of other disturbing factors and, according to E. R. Buckell, the present epidemic might well be influenced by over-grazing.

Factors which might contribute to the difference between the Nicola and Chilcotin outbreaks are far beyond the scope of this paper, but certain observations of Criddle in Manitoba might be of interest. Grasshoppers appear in a variety of habitats, from moist regions to the most arid. In two such regions, an annual precipitation double the normal would have very different effects. In the normally moist area, it might cause a heavy mortality, where in the arid region, it might be ideal for vegetation and also grasshoppers. The optimum rainfall for development would be the same in both places; although occurring in different phases of the sun spot cycle. He further points out that where grasshoppers are controlled by natural enemies, their increase is often first recorded at a phase of the sun spot cycle which, though perhaps less suitable for development, is free of natural enemies.

Bodkin (1929) has listed the years of maximum outbreaks of locusts in Palestine, from 1865-1928, and although he made no mention of sun spots, the accompanying graph shows their correlation in a marked degree, with the exception of 1928.

In so far as other insect outbreaks in British Columbia are concerned, data on hand is much too scarce to attempt a correlation with sun spots. Nevertheless, we have definite dates for the past three peaks of bark beetle outbreaks. These occurred about 1911-13, 1921-23 and 1931-33. The first two reached their peaks at the sun spot minimum, the latter about a year prior to the minimum. The periodicities of the

Hemlock Looper, **Ellopia somniaria** Hulst., show no apparent relation to the sun spot cycle, although it is hard to tell whether the earlier reference to this insect in British Columbia referred to small local infestations or general outbreaks.

While the data contained in this paper is of a limited nature, Dr. DeLury has stressed the value of any records on wild life which may help in presenting a comprehensive picture of the response of weather and living things to the astranomical cycles in various parts of Canada.*

Literature Cited

Bodkin, G. E. 1929 "The locust invasion of Palestine in 1928". Bull. Ento. Res. 20:123-139.

Chambers, G. F. 1909. "The Story of Eclipses". pp 65-69. The University Society Inc., New York.

Criddle, N. 1932. "The correlation of sun spot periodicity and grasshopper outbreaks." Can. Field Natur. 46:195-99.

De Lury, R. E. 1931 "Sun spots and forest life." Forest & Outdoors, 27; No. 6.

1932. "Sun spots and forest fires." Forest and Outdoors, 28, No. 5.

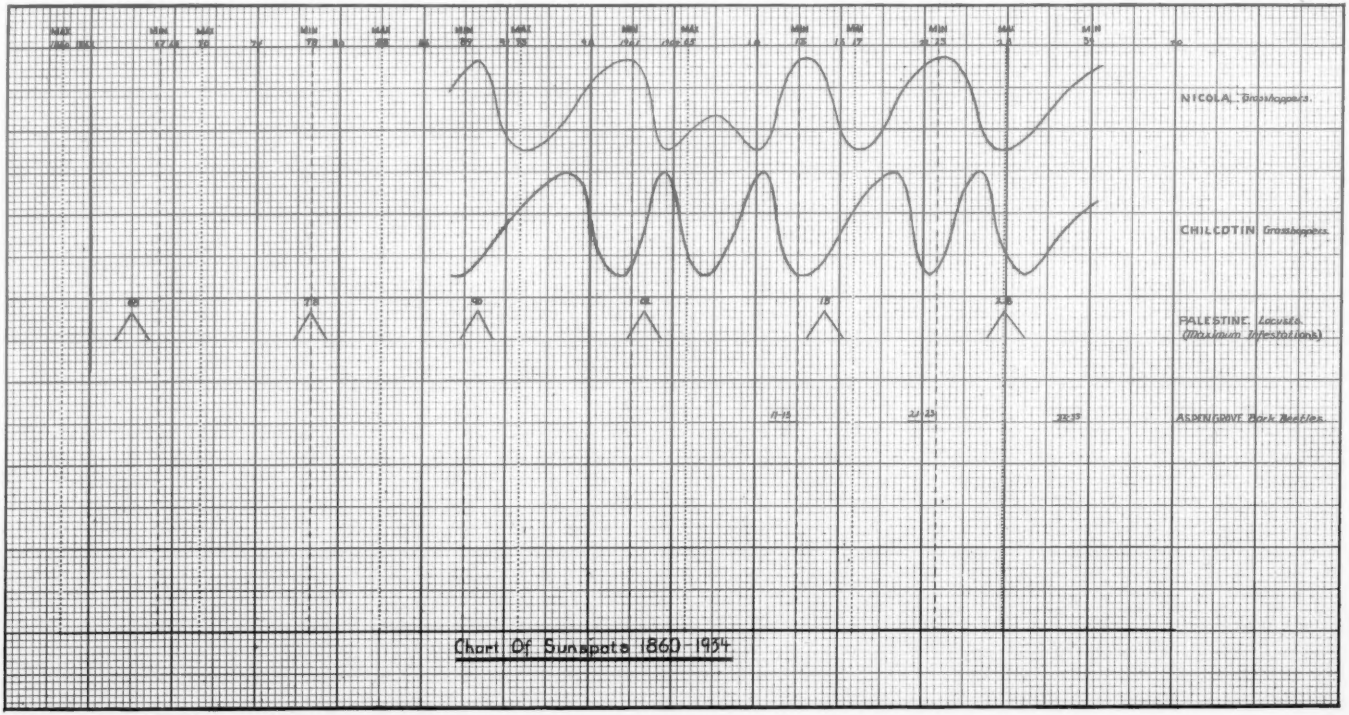
Middleton, A. D. 1932. "Cycles in animal life." Scottish Jour. Agric. 15: 146-52.

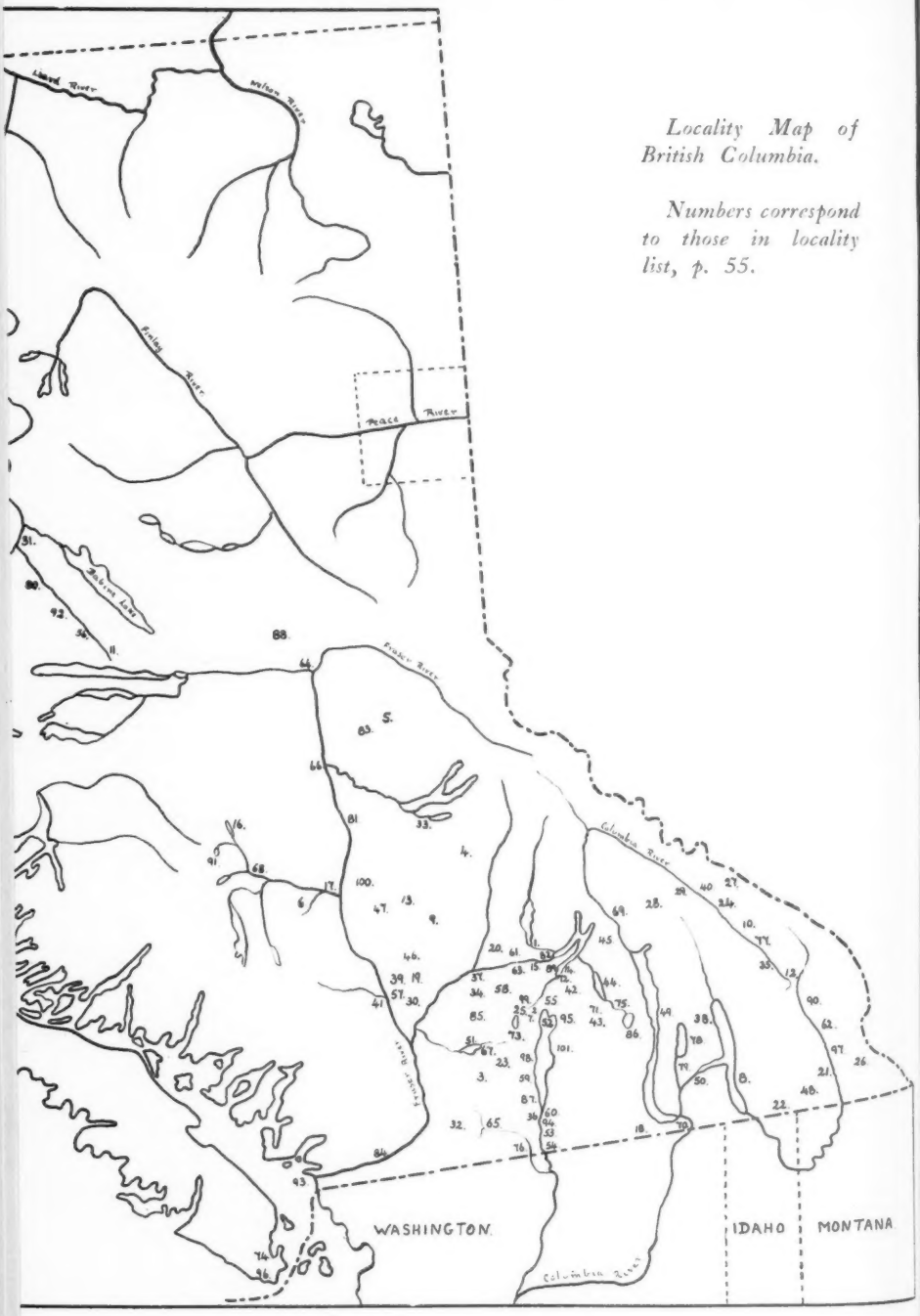
Swaine, J. M. 1914. "Forest Insect Conditions in British Columbia." Can. Dept. Agr. Ento. Pub. 7. pp. 41 figs. 22.

Swinton, A. H. 1883. "Locusts and Sunspots." 3rd Rep. U. S. Ento. Comm. Dept. Agr. Pages 65-85.

*Editor's Note: It has been pointed out by other writers that the present data with regard to insect outbreaks and sun spot cycles is far too meagre to preclude coincidence or chance.

CORRELATION OF SUN SPOT CYCLES AND SOME INSECT EPIDEMICS





Locality Map of British Columbia.

Numbers correspond to those in locality list, p. 55.

SOME LOCALITY RECORDS OF BRITISH COLUMBIA DRAGONFLIES

By E. R. Buckell
Dominion Entomological Laboratory, Vernon, B. C.—January, 1937

During the past few years the author has collected dragonflies in the interior of British Columbia.

No opportunity has occurred to make collecting trips, nor to spend any time searching for rare species. The material has been gathered together while on routine work connected with the Dominion Entomological Laboratory at Vernon, B. C., and has been determined for me by specialists.

Others, interested in the dragonflies of British Columbia and of Canada, and able to devote more time to this interesting study, are working upon publications which the author hopes may be assisted by this brief locality list.

The list consists only of the species actually in the collection of the Dominion Entomological Branch in the Vernon Laboratory. It makes no mention of other species, well known to occur within the province, but of which specimens with locality records are not on hand.

The localities are listed alphabetically and numbered, and the numbers marked on a map for reference. Sixty-two species and one geographic race; totalling 3854 specimens; are listed from 101 different localities. The number of specimens on hand in 95% grain alcohol is indicated in brakets following the localities, and, considered together with the number of localities, gives a rough indication of their relative abundance.

The author wishes to thank Dr. E. M. Walker, Dr. R. D. Bird, and Mr. F. C. Whitehouse, for determinations and information concerning synonomy, and members of the Dominion Entomological Branch for material collected.

Locality List

1.—Adams Lake
2.—Arthur Lake (Falkland)
3.—Aspen Grove
4.—Azure Lake
5.—Barkerville
6.—Big Creek (Chilcotin)
7.—Boleine Lake (Falkland)
8.—Boswell
9.—Bridge Lake
52.—Okanagan Landing
53.—Oliver
54.—Osoyoos
55.—Otter Lake (Armstrong)
56.—Palling
57.—Pavillion Lake
58.—Paxton Valley
59.—Peachland
60.—Penticton

10.—Brisco
11.—Burns Lake
12.—Canal Flats
13.—Canim Lake
14.—Canoe
15.—Chase
16.—Chezicut Lake
17.—Chilcotin
18.—Christina Lake
19.—Clinton
20.—Cold Creek (Kamloops)
21.—Cranbrook
22.—Creston
23.—Douglas Lake
24.—Edgewater
25.—Falkland
26.—Fernie
27.—Field
28.—Glacier
29.—Golden
30.—Hat Creek
31.—Hazelton
32.—Hope Mountains
33.—Horsefly
34.—Humphrey's Lake (Kamloops)
35.—Invermere
36.—Kaleden
37.—Kamloops
38.—Kaslo
39.—Kelly Lake
40.—Leanchoil
41.—Lillooet
42.—Loon Lake (Salmon Arm)
43.—Lumby
44.—Mabel Lake
45.—Malakwa
46.—70-Mile House
47.—150-Mile House
48.—Moyie
49.—Nakusp
50.—Nelson
51.—Nicola Lake
61.—Pinantan Lake
62.—Premier Lake
63.—Pritchard
64.—Prince George
65.—Princeton
66.—Quesnel
67.—Quilchena
68.—Redstone
69.—Revelstoke
70.—Robson (East)
71.—Rolling's Lake (Lumby)
72.—Salmon Arm
73.—Salmon Lake
74.—Shawnigan Lake
75.—Shuswap Falls
76.—Similkameen
77.—Sinclair
78.—Slocan Lake
79.—Slocan Park
80.—Smithers
81.—Soda Creek
82.—Squilax
83.—Stanley
84.—Steelhead
85.—Stump Lake
86.—Sugar Lake
87.—Summerland
88.—Summit Lake (Prince George)
89.—Tappen
90.—Ta Ta Creek
91.—Tatla Lake
92.—Topley
93.—Vancouver
94.—Vaseaux Lake
95.—Vernon
96.—Victoria
97.—Wasa
98.—Westbank
99.—Westwold
100.—Williams Lake
101.—Winfield

Order—**Odonata**
Suborder—**Zygoptera**
Family **Lestidae**

1. **Lestes congener** Hagen.—Aspen Grove; Azure Lake; Brisco; Clinton; Creston; Douglas Lake; Edgewater; Hat Creek; Humphrey's Lake (Kamloops); Invermere; Kaleden; Kamloops; 150-Mile House; Nelson; Okanagan Landing; Oliver; Osoyoos; Premier Lake; Prince George; Princeton; Quilchena; Revelstoke; Salmon Arm; Similkameen; Stump Lake; Sugar Lake; Summerland; Summit Lake (Prince George); Ta Ta Creek; Vaseaux Lake; Vernon; Wasa; Winfield (291)
2. **Lestes unguiculatus** Hagen.—Canal Flats; Hat Creek; Osoyoos; Premier Lake; Princeton; Wasa. (22)
3. **Lestes dryas** Kirby.—Aspen Grove; Bridge Lake; Boswell; Canal Flats; Canim Lake; Chilcotin; Douglas Lake; Falkland; Hat Creek; Horsefly; Humphrey's Lake (Kamloops); Invermere; Kamloops; Kaslo; Lillooet; Mabel Lake; 150-Mile House; Moyie; Revelstoke; Robson (East); Salmon Arm; Salmon Lake; Shuswap Lake; Shuswap Falls; Slocan Park; Stump Lake; Sugar Lake; Tatla Lake. (147)
4. **Lestes disjunctus** Selys.—Aspen Grove; Bridge Lake; Brisco; Canal Flats; Chase; Creston; Douglas Lake; Edgewater; Falkland; Field; Hat Creek; Hazelton; Invermere; Kaleden; Kamloops; Kaslo; Lumby; Mabel Lake; Malakwa; 150-Mile House; Moyie; Nakusp; Nelson; Okanagan Landing; Oliver; Osoyoos; Palling; Paxton Valley; Peachland; Premier Lake; Prince George; Princeton; Quesnel; Revelstoke; Robson (East); Rollings Lake (Lumby); Salmon Arm; Salmon Lake; Shuswap Falls; Stump Lake; Sugar Lake; Summit Lake (Prince George); Tappen; Vernon; Wasa; Winfield. (379)

Family **Coenagrionidae**

5. **Argia vivida** Hagen.—Field. (20)
6. **Argia emma** Kennedy.—Christina Lake; Lillooet; Mabel Lake; Oliver; Penticton. (30)
7. **Amphiagrion abbreviatum** Selys.—Canoe; Hat Creek; Kaleden; Lumby; Salmon Arm; Vernon. (199)
8. **Nehalennia irene** (Hagen).—Chase; Salmon Arm. (84)
9. **Coenagrion resolutum** (Hagen).—Big Creek (Chilcotin); Canim Lake; Hat Creek; Horsefly; Redstone; Tatla Lake. (18)
10. **Enallagma boreale** (Selys).—Aspen Grove; Boleine Lake (Falkland); Bridge Lake; Canal Flats;

Canim Lake; Chase; Chilcotin; Clinton; Cold Creek (Kamloops); Douglas Lake; Falkland; Hat Creek; Humphrey's Lake (Kamloops); Kamloops; Lumby; Malakwa; Oliver; Osoyoos; Paxton Valley; Pavillion Lake; Penticton; Prince George; Princeton; Quesnel; Redstone; Revelstoke; Robson (East); Rollings Lake (Lumby); Salmon Arm; Similkameen; Sugar Lake; Ta Ta Creek; Tatla Lake; Vancouver; Vernon; Westbank; Williams Lake. (200)

11. **Enallagma cyathigerum** (Charpentier).—Bridge Lake; Brisco; Canim Lake; Chase; Chilcotin; Clinton; Creston; Douglas Lake; Edgewater; Falkland; Hat Creek; Humphrey's Lake (Kamloops); Invermere; Kamloops; Kelly Lake; Lumby; 150-Mile House; Oliver; Paxton Valley; Penticton; Premier Lake; Prince George; Princeton; Quesnel; Redstone; Rollings Lake (Lumby); Salmon Arm; Salmon Lake; Shuswap Falls; Soda Creek; Stump Lake; Tatla Lake; Vernon; Victoria; Winfield; Williams Lake. (311)

12. **Enallagma clausum** Morse.—Osoyoos; Penticton. (17)

13. **Enallagma ebrium** (Hagen).—Bridge Lake; Boswell; Falkland; Kamloops; Summit Lake (Prince George); Tappen; Vernon; Wasa. (50)

14. **Enallagma carunculatum** Morse.—Bridge Lake; Canim Lake; Christina Lake; Douglas Lake; Mabel Lake; Nakusp (Box Lake); Okanagan Landing; Oliver; Osoyoos; Penticton; Salmon Arm; Sugar Lake; Vernon. (63)

15. **Ischnura cervula** Selys.—Aspen Grove; Bridge Lake; Chase; Christina Lake; Falkland; Kaleden; Kamloops; Lumby; Nakusp (Box Lake); Okanagan Landing; Oliver; Osoyoos; Otter Lake (Armstrong); Peachland; Penticton; Redstone; Revelstoke; Robson (East); Rollings Lake (Lumby); Salmon Arm; Tappen; Vancouver; Vaseaux Lake; Vernon; Victoria; Winfield. (172)

16. **Ischnura perparva** Selys.—Bridge Lake; Kaleden; Lumby; Oliver; Osoyoos; Peachland; Penticton; Revelstoke; Robson (East); Similkameen; Vaseaux Lake; Victoria. (62)

Suborder **ANISOPTERA**

Family **Aeschnidae**

17. **Aeschna sitchensis** Hagen.—Field. (22)

18. **Aeschna juncea** Linnaeus.—Field; Kamloops; Leanchoil; Lumby; Penticton; Quesnel; Sinclair. (33)

19. **Aeschna subarctica** E. Walker.—Field. (1)

20. **Aeschna interrupta** E. Walker.—No attempt has been made to separate the material on hand into geographic races, of which several are probably represented. Over one hundred specimens from all parts of the province are available for study.—Falkland; Golden; Hat Creek; Kaleden; Lumby; Malakwa; Nicola Lake; Oliver; Palling; Peachland; Prince George; Princeton; Quesnel; Revelstoke; Salmon Arm; Sinclair; Slocan Lake; Soda Creek; Vernon; Winfield. (109)

21. **Aeschna eremita** Scudder.—Aspen Grove; Bridge Lake; Canal Flats; Clinton; Douglas Lake; Edgewater; Falkland; Kamloops (Lac la Jeune); Kaslo; Malakwa; Prince George; Princeton; Salmon Arm; Sinclair; Soda Creek; Tappen; Topley; Vernon; Winfield. (61)

22. **Aeschna canadensis** E. Walker.—Malakwa; Prince George (Summit Lake); Salmon Arm. (4)

23. **Aeschna palmata** Hagen.—Aspen Grove; Boswell; Bridge Lake; Burns Lake; Cranbrook; Douglas Lake; Falkland; Field; Golden; Hat Creek; Hazelton; Humphrey's Lake (Kamloops); Kamloops; Kaslo; Loon Lake (Salmon Arm); Mabel Lake; Malakwa; Moyie; Nakusp; Nelson; Okanagan Landing; Oliver; Peachland; Premier Lake; Prince George; Quesnel; Revelstoke; Robson (East); Rollings Lake (Lumby); Salmon Lake; Shuswap Falls; Similkameen; Sinclair; Slocan Lake; Slocan Park; Smithers; Soda Creek; Topley; Vernon; Wasa; Westbank; Winfield. (175)

24. **Aeschna umbrosa umbrosa** E. Walker.—Smithers; Quesnel (Atypical). (3)

24a. **Aeschna umbrosa occidentalis** E. Walker.—Creston; Falkland; Golden; Mabel Lake; Okanagan Landing; Quesnel; Sugar Lake; Vancouver; Vernon; Wasa. (20)

25. **Aeschna constricta** Say.—Creston. (20)

26. **Aeschna californica** Calvert.—Aspen Grove;; Salmon Arm; Squilax; Tatla Lake; Vancouver; Vernon; Victoria; Westbank. (21)

27. **Aeschna multicolor** Hagen.—Adams Lake; Salmon Arm; Squilax; Victoria. (53)

28. **Anax junius** Drury.—Oliver; Salmon Arm. (4)

Family **Gomphidae**

29. **Ophiogomphus severus montanus** (Selys).—Adams Lake; Aspen Grove; Canim Lake;

Chilcotin (Chezicut) Lake; Mable Lake; Princeton; Salmon Arm; Summerland. (71)

30. **Ophiogomphus occidentis** Hagen.—Lillooet; Pritchard. (2)
31. **Gomphus graslinellus** Walsh.—Salmon Arm. (8)
32. **Gomphus olivaceous** Selys.—Pritchard. (1)

Family **Cordulegasteridae**

33. **Cordulegaster dorsalis** Hagen.—Shawnigan Lake. (1)

Family **Corduliidae**

34. **Cordulia shurtleffi** Scudder.—Aspen Grove; Barkerville; Bridge Lake; Canim Lake; Kamloops (Lac la Jeune); Malakwa; Pinantan Lake; Prince George; Princeton; Quesnel; Revelstoke; Salmon Arm; Vancouver. (67)
35. **Somatochlora franklini** Selys.—Field. (2)
36. **Somatochlora semicircularis** Selys.—Chilcotin; Fernie; Field; Moyie; Prince George, Quesnel; Revelstoke; Slocan Park; Stanley. (21)
37. **Somatochlora albicincta** (Burmeister).—Arthur Lake (Falkland); Revelstoke; Salmon Arm (Fish Lake). (44)
38. **Somatochlora hudsonica** (Hagen).—Arthur Lake (Falkland); Bridge Lake; Lac la Jeune (Kamloops); Salmon Arm. (24)
39. **Somatochlora cingulata** (Selys).—Arthur Lake (Falkland). (10)
40. **Tetragoneuria spinigera** (Selys).—Squilax; Vernon. (3)
41. **Macromia magnifica** McLachlan.—Vernon. (1)
42. **Macromia rickeri** E. M. Walker.—Salmon Arm. (2)

Family **Libellulidae**

43. **Libellula exusta julia** Uhler.—Horsefly; Loon Lake (Salmon Arm); Oliver; Osoyoos. (30)
44. **Libellula quadrimaculata** Linnaeus.—Aspen Grove; Chilcotin (Big Creek); Clinton; Douglas Lake; Edgewater; Hat Creek; Horsefly; Oliver; Osoyoos; Princeton; Revelstoke; Rollings Lake (Lumby); Salmon Arm; Steelhead; Vancouver; Victoria; Westbank. (36)
45. **Libellula pulchella** Drury.—Oliver; Osoyoos; Peachland; Revelstoke; Rollings Lake (Lumby); Salmon Arm; Vaseaux Lake. (39)

46. **Libellula forensis** Hagen.—Christina Lake; Oliver; Osoyoos; Salmon Arm; Vancouver; Victoria. (8)

47. **Libellula lydia** (Drury).Oliver; Vancouver; Victoria. (6)

48. **Sympetrum corruptum** (Hagen).—Cranbrook; Creston; Hope Mountains; Kamloops (Pass Lake); Nelson; Oliver; Osoyoos; Peachland; Penticton; Wasa. (40)

49. **Sympetrum illotum** (Hagen).—Victoria. (1)

50. **Sympetrum madidum** (Hagen).—Aspen Grove; Bridge Lake; Canim Lake; Hat Creek; 70-Mile House; Osoyoos; Princeton; Salmon Arm; Tatla Lake. (74)

51. **Sympetrum pallipes** (Hagen).—Christina Lake; Douglas Lake; Mable Lake; Moyie; Nelson; Okanagan Landing; Oliver; Osoyoos; Quilchena; Stump Lake; Vaseaux Lake; Victoria; Wasa. (40)

52. **Sympetrum vicinum** (Hagen).—Victoria (1)

53. **Sympetrum obtrusum** (Hagen).—Arthur Lake (Falkland); Creston; Falkland; Kamloops; Lumby; Mable Lake; Malakwa; 150-Mile House; Nakusp (Box Lake); Oliver; Osoyoos; Paxton Valley; Peachland; Premier Lake; Quesnel; Rollings Lake (Lumby); Salmon Arm; Shuswap Falls; Slocan Park; Sugar Lake; Summerland; Tappen; Vernon; Wasa; Winfield. (145)

54. **Sympetrum decisum** (Hagen).—Aspen Grove; Bridge Lake; Burns Lake; Canal Flats; Canim Lake; Creston; Hat Creek; Humphrey's Lake (Kamloops); Kamloops; Lumby; 150-Mile House; Nelson; Oliver; Osoyoos; Prince George; Princeton; Revelstoke; Robson (East); Rollings Lake (Lumby); Salmon Arm; Slocan Lake; Stump Lake; Summerland; Vaseaux Lake; Wasa; Westwold. (164)

55. **Sympetrum semicinctum** (Say).—Brisco; Canal Flats; Clinton; Creston; Edgewater; Field; Invermere; Kamloops; Mable Lake; Nelson; Okanagan Landing; Oliver; Osoyoos; Revelstoke; Shuswap Falls; Sinclair; Vaseaux Lake; Vernon; Wasa. (56)

56. **Sympetrum costiferum** (Hagen).—Brisco; Clinton; Creston; Edgewater; Invermere; Mable Lake; Nelson; Oliver; Peachland; Premier Lake; Princeton; Salmon

Arm; Tappen; Vancouver; Vaseaux Lake; Vernon; Wasa; Winfield. (88)

57. **Sympetrum danae** (Sulzer).—Burns Lake; Canal Flats; Chase; Clinton; Creston; Edgewater; Field; Hat Creek; Invermere; Kamloops; 150-Mile House; Oliver; Osoyoos; Peachland; Prince George; Princeton; Quesnel; Revelstoke; Salmon Arm; Similkameen; Slocan Park; Smithers; Soda Creek; Stump Lake; Summerland; Summit Lake (Prince George); Vernon; Wasa. (80)

58. **Leucorrhinia hudsonica** (Selys).—Arthur Lake and Boleine Lake (Falkland); Aspen Grove; Chilcotin; Chase; Quesnel; Salmon Arm; Summit Lake (Prince George). (25)

59. **Leucorrhinia intacta** (Hagen).—Chase; Creston; Oliver; Osoyoos; Salmon Arm; Vancouver; Victoria; Westbank. (31)

60. **Leucorrhinia glacialis** Hagen.—Chase; Horsefly; Loon Lake (Salmon Arm); Salmon Arm (Johnson's Pond). (35)

61. **Leucorrhinia proxima** Calvert.—Aspen Grove; Bridge Lake; Chase; Chilcotin; Horsefly; Malakwa; Oliver; Osoyoos; Princeton; Quesnel; Revelstoke; Salmon Arm; Summit Lake (Prince George); Tatla Lake; Westbank. (87)

62. **Leucorrhinia borealis** Hagen.—Big Creek (Chilcotin). (8)

OBITUARY

Alice McDougall Patterson

Mrs. Alice McDougall Patterson, collector of and authority on the Aphids of British Columbia, died in Vancouver on 5th November, 1935.

Alice McDougall was born in Minnesota and received her primary education in that State. Her father moved to Terrace, B. C., where Alice lived a few years and then attended McMaster University at Toronto where she was granted a B.A. degree. Upon the death of her father, she made her home with an aunt in New Westminster and attended the University of British Columbia at Vancouver where she took her Master of Arts degree in Biology, specializing in the study of Aphids.

She was an energetic and enthusiastic collector and soon had a large number of friends sending in specimens from many points in the Province. Moreover, she corresponded with specialists all over North America and when she returned to Toronto for the doctor's degree, she took advantage of scientific meetings in the East to become acquainted with many leading Entomologists on this continent. At Toronto, she complied with all requirements for her final degree, including a thesis on "The Classification of the Aphids of British Columbia," but did not take the final examinations.

In 1926 she married Mr. P. G. Patterson, a geologist now in Bolivia, but spent most of her time in Canada, working in her private laboratory at New Westminster. By 1933, she had over 200 named species of Aphids and a considerable number of undescribed species. At this time she contracted tuberculosis from which she died two years later.

She had many other interests besides Entomology and engaged in several commercial undertakings.

In the spring of 1936, her husband returned to Vancouver to wind up her estate and very generously presented her entire collections to the University. These consist of nearly 1,000 microscope slides, representing 211 species of Aphids, a very large number of mounted slides, tentatively identified, some 700 collections of aphids in alcohol and a large amount of general laboratory equipment of all kinds. Of particular importance is her library of books, bulletins and separates dealing entirely with Aphids.

—G. J. Spencer

ENTOMOLOGICAL SOCIETY OF BRITISH COLUMBIA
REPORT OF THE SECRETARY-TREASURER

For the Year Ending February 27, 1937

Herewith, I wish to present this report, briefly covering the activities of this Society for the past year.

Finances

The present bank balance as indicated and audited is $226.70. Out of this must come the payment for the issue of the Proceedings now in your hands, which will probably leave a rather slim balance. You will note from the financial statement that a donation of $8.00 has been made by a member to the reserve fund. I am sure the Society appreciates such support and it is to be hoped that more members will follow this example and build up the reserve fund as rapidly as possible. A little later in this meeting I shall present a new plan with regard to this fund.

Proceedings

The publication is costing more and more each year owing to increased cost of labour and materials. In addition, the present number is somewhat larger than usual. If it were published on a quarterly basis it is possible that a contract price for the four numbers could be obtained. As a quarterly, the publication would immediately command a subscription rate. Several entomologists recently have remarked on the interest created by our publication, owing to the diversity of subjects dealt with. You will please note that separates have been provided for all contributors except in the case of lists, catalogues, etc.

Membership

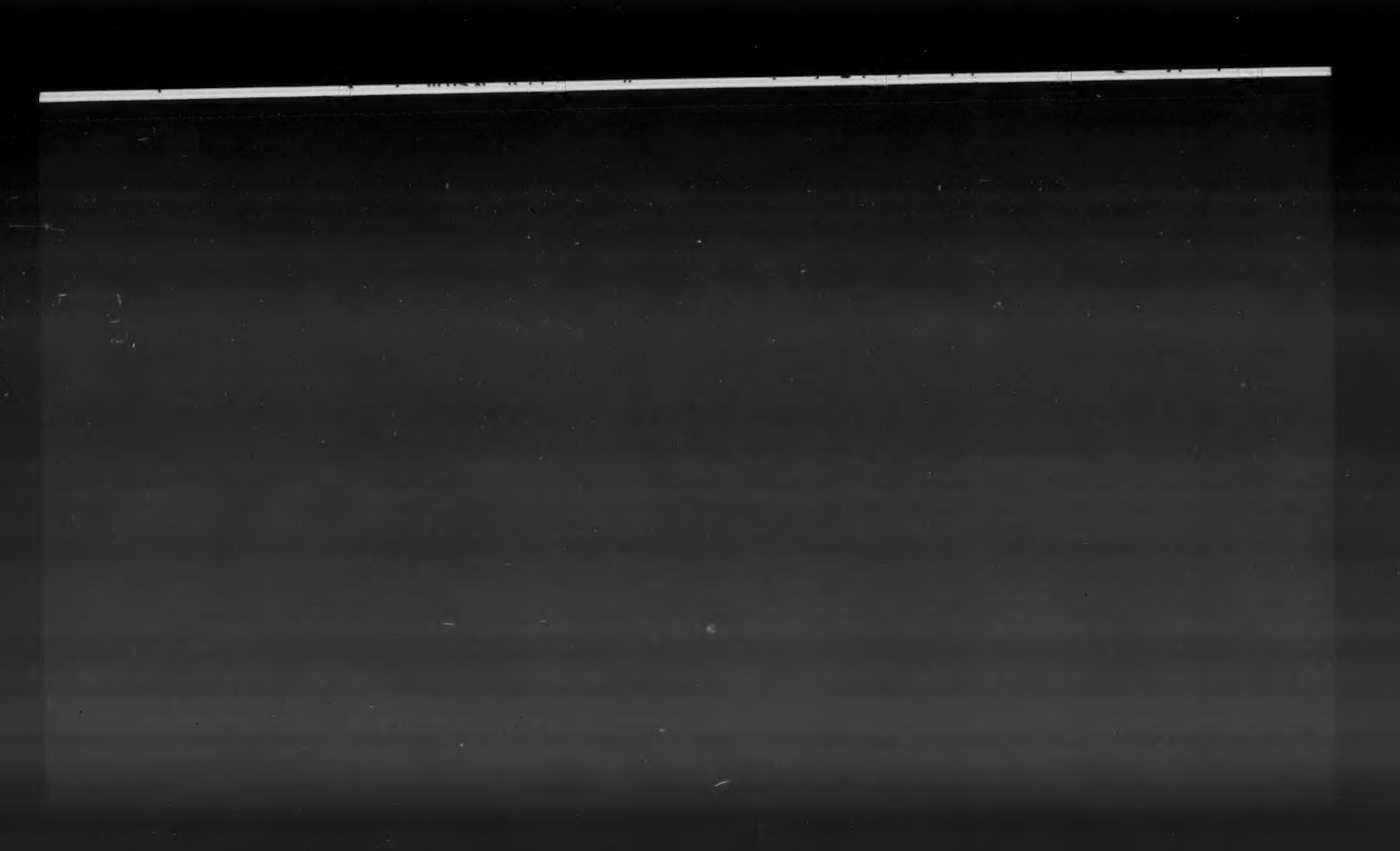
At present the members in good standing number forty-three. During the past year I have eliminated quite a number who have not maintained an active interest in the Society. New members to be elected at this meeting may possibly bring the number of active members to fifty.

Library

In connection with the library, I should like to submit for your inspection two beautifully prepared volumes which have been presented to us by the Trustees of the British Museum. One is a very complete work on the Genus Erebia of the World by B. C. S. Warren. The other is on the Mosquitoes of Ethiopia by G. H. E. Hopkins.

Respectfully submitted,

GEO. R. HOPPING.

DIRECTORS OF THE ENTOMOLOGICAL SOCIETY OF BRITISH COLUMBIA

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